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69

THE WILSON BULLETIN

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CONTENTS

A Hybrid Tanager From Minnesota — Harrison B. Tordoff 3

Barometric Pressure Patterns and Spring Migration — A. M. Bagg, W. W. H. Gunn, D. S. Miller, J. T. Nichols, Winnifred Smith, and F. P. Wolfarth 5

The Wing Molt of the Bob-White — Donald R. Thompson and Cyril Kabat 20

Bird Transects on the North Atlantic — Robert L. Grayce 33

General Notes 37

Book Reviews 43

Museum
QL
671
.W75

THE PRESIDENT'S PAGE

Probably the most widely read part of *The Wilson Bulletin* is the section headed "General Notes." Because the subject matter is varied, we are almost certain to find contributions which interest us in one way or another.

Unfortunately our Editor does not receive for this section, in sufficient quantity, the type of material most greatly desired. The majority of manuscripts submitted are anecdotal or pertain to distributional records, often too local to be either of much ornithological significance or of much reader interest. Greatly needed are concise, factual manuscripts which will serve to augment our knowledge of the biology of birds.

Last year (vol. 61, p. 131) I pointed out several gaps in our knowledge of birdlife, namely, length of incubation periods, length of nestling life, daily activity rhythms, clutch size, location of roosting sites, and water requirements. Observations on these aspects of birdlife are admirably suited to "General Notes." In addition, observations on the following problems are equally well suited.

Predation upon birds. Our ornithological literature contains abundant suppositions as to the kinds of predators that destroy nests and adult birds, but relatively few observations of the "predator in the act."

Nest-building. In the case of many of our commonest birds, we do not know the actual mechanics of the process, the role of the sexes, and the length of time involved.

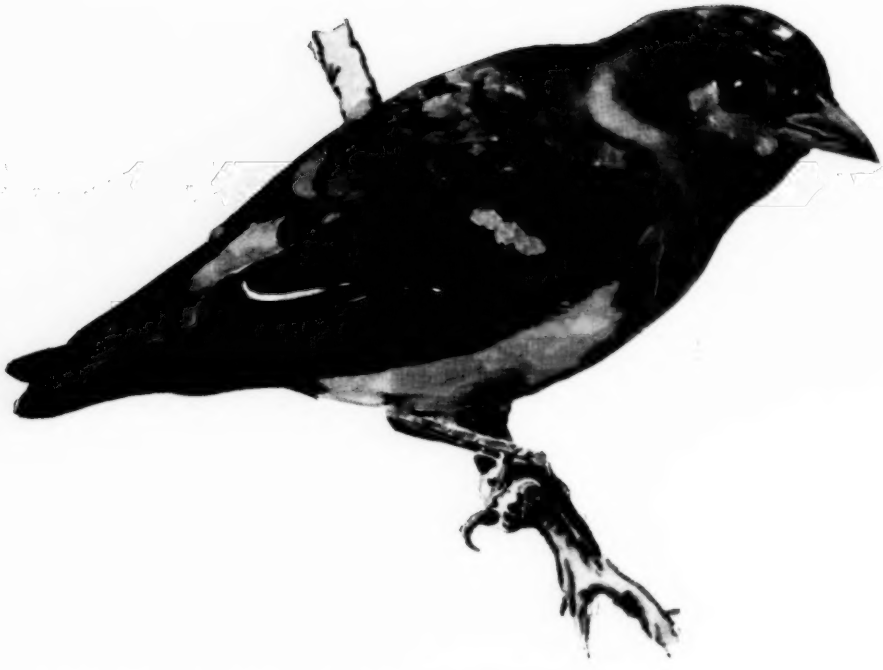
Mating displays. The mating displays of most small birds, especially passerine birds, have been ignored. Because the mating display of a bird such as the Blue Jay is not as showy as that of a peafowl, no attention has been paid to it.

Parental defense. Although an extraordinary number of observations have been made on the "injury-feigning" of parent birds, we have few published descriptions of threat-displays, direct attacks, and warning sounds.

Multiple-broodedness. We need to know which species regularly rear two or more broods in a season. Determinations should be based on birds which have been marked (*e.g.*, color-banded) so as to be individually recognized.

More "General Notes" based on the type of information suggested above will serve the dual purpose of contributing to knowledge and increasing reader interest.

OLIN SEWALL PETTINGILL, JR.



A HYBRID BETWEEN THE SCARLET AND THE WESTERN TANAGER

Piranga olivacea × *Piranga ludoviciana*

From a water color by Robert M. Mengel, based on a specimen taken in Anoka County, Minnesota, August 17, 1949.

A HYBRID TANAGER FROM MINNESOTA

HARRISON B. TORDOFF

Museum of Zoology, Ann Arbor, Michigan

ON AUGUST 17, 1949, Dwain W. Warner, Dana Struthers, and I collected an oddly plumaged tanager (*Piranga*) 5 miles northwest of Wyoming, Anoka County, in east-central Minnesota. The specimen proved to be a male with a completely ossified skull. It weighed 32.0 grams and had some fat. Its testes measured about 2.00 x 0.75 mm. It was molting, the longest tail feathers extending scarcely a half inch beyond the tips of the fully developed upper tail coverts.

The accompanying plate illustrates the peculiar plumage, perhaps more effectively than a written description. The crown of the specimen is mottled with black-tipped greenish-yellow feathers and orange-red feathers. The rest of the head, hind neck, upper back, throat, and upper breast are less intense orange-red, with scattered yellow feathers. The middle of the back is mottled with yellowish-green, black, and orange-red. The rump, lower breast, and belly are largely yellow, with a few orange-red feathers interspersed. The flanks are greenish-yellow, and the tail coverts are reddish-orange. The feathers of the crural tract are black, tipped with greenish-yellow. The tail and wings are black, with greenish-yellow edges on some of the middle and greater secondary wing coverts.

At first sight, the bird appears to be an adult male Scarlet Tanager (*Piranga olivacea*) in postnuptial molt; however, it resembles the Western Tanager (*Piranga ludoviciana*) in several respects. First, the orange-red of the feathers is much closer to that on the throat and chin of the male Western Tanager than it is to the red of the normal male Scarlet Tanager. Exceptionally, however, the head and body plumage of the breeding male Scarlet Tanager is orange-red rather than scarlet. The scattering of red feathers over the body indicates the Scarlet Tanager since in the Western, the red occurs only on the head and (occasionally) some of the breast feathers. Second, in the Minnesota specimen, the well-defined greenish-yellow tips of three of the middle coverts form a single short wing-bar on either side. The Western Tanager has 2 conspicuous yellow wing-bars, while the Scarlet has them only very rarely. Third, the newly replaced outermost tertial of the specimen has a white tip (1.5 mm. wide). The Scarlet Tanager occasionally has a narrow, light edging on the inner secondaries, while the Western customarily has fairly broad edgings in fresh plumage which are about 1 to 2 mm. wide. In fresh plumage, the tail of the Western is white-tipped (always?), while this tipping is lacking in the Scarlet and in the specimen figured. Fourth, the middle of the back of the

Minnesota specimen is mottled with black. This black involves parts of some scapulars and interscapulars. On some of the interscapulars, there are two distinct black bars, separated by a band of orange-red or green. The entire middle of the back is black in both plumages of adult male Western Tanagers, and either red or green in the two plumages of adult male Scarlets, although a male Scarlet in the P. W. Shufeldt Collection, taken October 9, 1932, at Belize, British Honduras, has slight traces of black on some of the back feathers. A fifth point, more difficult to account for, is the black mottling on the crown of the Minnesota bird. In this regard, I can only point out that an adult male Western Tanager in the P. W. Shufeldt Collection from Mora County, New Mexico, September 24, 1939, has definitely black-tipped feathers on the crown, throat, and upper breast. Lastly, the bill of the Western Tanager tends to be slightly less swollen than that of the Scarlet Tanager. Ridgway (Birds of North and Middle America. Part 2. *U. S. Nat. Mus. Bull.* No. 50, 1902, pp. 89 and 93) gives the range of bill depth at base for 14 adult male Scarlet Tanagers as 8.9 to 9.7 mm. (average 9.4), and for 12 adult male Western Tanagers, 7.9 to 8.6 mm. (average 8.1). The bill depth of the Minnesota specimen is 8.1 mm.

I examined the red feathers of the head under a magnification of 18 × to determine whether any of them belong to the incoming plumage, since the male Western Tanager retains some red on the head in winter, while the male Scarlet ordinarily loses all of the red feathers in the postnuptial molt. The new feathers on the specimen can readily be distinguished from the old on the basis of wear. As far as I can tell, all of the red feathers are badly worn, whereas all of the yellow head feathers and many of the yellow body feathers are fresh and unworn. This indicates that in full winter plumage this individual would have shown very little or no red. However, the presence of many badly worn yellow feathers on the body indicates that in full breeding plumage, this individual must have had a wholly red head, with a yellow- and red-mottled body.

A consideration of all the factors involved has led me to conclude that the Minnesota bird is a hybrid between the Western and Scarlet Tanager– the first known as far as I have been able to ascertain. Hybrids have been recorded between several other east-west allopatric species in North America. These hybrids provide additional evidence of the close relationship existing between their parent species.

Roberts (The Birds of Minnesota, Vol. 2. Second Edition. Minneapolis, 1936, p. 329) lists two May sight records for the Western Tanager at Minneapolis, about 35 miles southwest of the Anoka County locality of the specimen figured. He gives the status of the Scarlet Tanager in Minnesota as "summer resident, breeding throughout the state" (loc. cit.). The specimen discussed above is now in the collection of the Minnesota Museum of Natural History, University of Minnesota.

BAROMETRIC PRESSURE-PATTERNS AND SPRING BIRD MIGRATION

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AS PREPARATORY background for studies of the relation between barometric pressure-patterns and spring migration in North America east of the Rocky Mountains, this paper reviews the relevant literature and outlines current studies of the correlation and its practical applications. In setting the Rocky Mountains as a western boundary for the region under discussion, the authors recognize the distinction between migration phenomena east and west of a line approximated by the 100th meridian, as emphasized by Peterson (1948: 165–6, 233). The southern and eastern boundaries can be defined as the Gulf states and the Atlantic coast, respectively; but the northern boundary must at present be left in vague outline, roughly represented by Lat. 50° N., due to lack of pertinent data.

The authors wish to acknowledge valuable assistance generously given by the following persons: Margaret M. Nice, James L. Peters, and Wendell Taber, who offered helpful criticism of the manuscript; W. B. Alexander, James L. Baillie, Roland Clement, Samuel A. Eliot, Jr., Joseph J. Hickey, and R. M. Saunders who made available certain references and field records; and R. E. Lautzenheiser, meteorologist, of the U. S. Weather Bureau, Chicago, who was consulted in regard to the section on meteorological definitions.

Introduction

The basic concepts of modern meteorology are treated in Haynes (1947) and government or newspaper weather maps provide accompanying definitions of the terms and symbols used thereon. As a ready reference for readers unfamiliar with meteorological terms, the following greatly simplified synopsis is presented:

The modern analysis of weather is based on the concept of large moving air masses which are labelled according to their source and the type of surface

from which they have derived their characteristics of temperature and humidity: *Tropical* or *Polar*, *Continental* or *Maritime*. Within itself, an air mass retains its individual character, although it will tend to be modified, in the lower levels, by the region over which it is passing. When 2 masses of different properties (such as a warm, moist Maritime Tropical air mass and a cold, dry Continental Polar air mass) adjoin one another, they produce a boundary in which the cold air tends to push in a shallow wedge under the warm air, and the warm air rises over the cold air. A "wave" appears in the boundary and the 2 air masses tend to whirl together. This disturbance takes on a roughly circular form and creates a *depression* or *low pressure area*.

The boundary between the 2 air masses will now be represented by 2 marked surfaces of discontinuity of temperature and wind direction, radiating from a point at or near the center of the Low. Where these surfaces of discontinuity touch the earth's surface, they are called surface *fronts*. Where cold air is replacing warm air, the front is termed a *cold front* and is indicated on weather maps by a line bearing triangular points showing the direction of movement. Where warm air is replacing cold air, the front is termed a *warm front*, indicated by half-circles on the frontal line. The pronounced sector of the low pressure area lying between the cold front and the warm front is termed the *warm sector*. A frontal line with alternate triangular points and half-circles represents a *quasi-stationary front*, where the leading edge of the cold air mass is relatively stationary.

Air tends to flow towards a low pressure area (cyclone) from a high pressure area (anticyclone) but, due to the rotation of the earth, this flow occurs spirally rather than directly. In the northern hemisphere, winds blow in a clockwise direction around centers of high pressure and counterclockwise around centers of low pressure.

Several early examples might be cited to show that, for many years, ornithologists have been interested in the relation between weather conditions and spring bird migration in our temperate latitudes. For example, in discussing migrating birds, Nuttall (1832: 22–23) stated: "It is possible that at times they may be directed principally by atmospheric phenomena alone. . . . The currents of the air, in those which make extensive voyages, are sedulously employed; and hence, at certain seasons, when they are usually in motion, we find their arrival or departure accelerated by a favorable direction of the winds." Also, Thoreau (1881: 159–161) wrote in his (Concord, Mass.) Journal, under date of March 17, 1858: "A remarkably warm and pleasant day with a south or southwest wind. . . . Thus these four species of birds [Bluebird, Flicker, Robin, and Redwing] all come in one day, no doubt, to almost all parts of the town."

However, in order to understand the correlation of weather and migration

it is first of all necessary to distinguish between 2 types of migration "waves" regularly observed in the region under discussion. These are superficially somewhat similar, but actually stem from divergent meteorological conditions: (1) the *arrested wave*, checked by adverse weather, and (2) the *onrushing wave*, impelled forward by favorable conditions.

The difference between the two is well illustrated by a passage from Batchelder (1882: 252), who analyzed weather's relation to the northward course of a "tidal wave" of birds observed consecutively at Washington, D. C., New York City, and Boston, Mass. He interpreted the correlation as follows: "The vast number of birds [noted at Washington] was doubtless due to the cold and rainy weather that prevailed, checking the progress of the migration beyond the latitude of Washington [arrested wave]. When the weather changed, the gradually accumulated throng was let loose, and rushed in a great [onrushing] wave towards the northern breeding grounds. In the vicinity of New York . . . after prolonged cold and wet weather a change came on the morning of May 20, and with the pleasant weather the rush of birds began. Almost all the Warblers and Thrushes were in great numbers, and continued very abundant at least throughout the following day. In the latitude of Boston birds had been unusually scarce for some days. The change to clear and warmer weather took place about noon of the 21st, and before the rain ceased the rush of birds had begun. All day long the smaller birds came in unheard of numbers, stopping awhile to feed, and then hurrying on [onrushing wave]. The next morning the host was even greater, and the trees fairly swarmed with Warblers. Before noon of that day most of the birds had passed on, but for a day or two afterward the number of loiterers was sufficient to be noticeable. . . ."

Among more recent authorities, both types of waves are implicit in statements by Cruickshank (1942: 39–40), Griscom (1945: 103) and Nichols (1948: 126, 130). A specific modification of this correlation is given by Nice (1937: 55), who writes of the Song Sparrow: "The early migration is absolutely dependent upon a warm wave the last of February or the first of March, but the main migration is only relatively dependent on a rise in temperature. Severe cold waves stop migration short."

The above analyses have emphasized significant temperature-rise and a southerly wind as the meteorological key to the onrushing wave. As a working formula, that emphasis has been most useful in anticipating occasions of noteworthy vernal movement. Generally speaking, however, ornithologists have paid very little attention to the study of the barometric pressure-patterns which produce the warm waves which, in turn, favor migratory movement in spring. Since it is this particular aspect which has been, in recent years, the subject of investigation by the authors, it consequently seems fitting to present the following references which treat the problem.

Early North American References (1888–1937)

In his "Report on Bird Migration in the Mississippi Valley in the Years 1884 and 1885", Cooke (1888: 16–25) included a section entitled "Relation of Migration to Barometric Pressure and Temperature". This section presents a detailed "record of the relation of migration to atmospheric conditions for the seven days from March 19 to 25, 1884, contrasted with a week's migration in May". Discussing the period of March 19–25, 1884, Cooke described a situation (since found to be typical, in a general way, of that season of the year) in which the center of a low pressure area is moving from "the southern Rocky Mountain region" progressively northeastward through North Platte (Nebraska), Yankton (S. Dakota), St. Paul (Minn.) and Marquette (Mich.). He describes the night of March 21 as being "a night of much migration", but one in which the movements took place "only to the east of the low pressure area; for it is a law of atmospheric circulation that the winds are attracted from the south, not directly toward the center of the low pressure area, but toward places to the east of it in the same direction that it is moving, while the winds which it attracts from the north move toward places to the west or behind it. Migration, therefore, would be looked for in vain to the south, west, or north [of the low pressure center]. . . . It is well to bear in mind that all these birds were migrating on a rapidly falling barometer, hence in the face of what is usually considered a sign of an approaching storm".

Before leaving Cooke, there are two further passages which are of importance in subsequent discussion: First: "Since it is known that low pressure is generally accompanied by clouds and rain, while areas of high pressure are cloudless, it would be naturally supposed that migration would take place during high pressure; but, as has already been stated, the area of low pressure attracts a south wind and the increased warmth more than overbalances the cloudiness. Fully 60 per cent of the spring migration of 1884 took place in cloudy weather". Second: Describing an instance in May in which there seemed "to have been a regular though not rapid advance . . . with N. and NW. wind", Cooke was led to the inference that "during the latter part of migration there is no night so unfavorable but that some migration takes place".

In reporting on the 1902 spring migration at Rochester, N. Y., Eaton (1904: 344) observed that "the greatest bird wave of the season . . . occurred on the 3rd of May . . . a perfect day, warm and sunny, following a low cyclonic center moving from the southwest and culminating in a shower during the night". Eaton added that "during the warbler season of 1903 there was no decided southwest cyclonic storm and no remarkable warbler wave". Moreover, Eaton (1910: 67) made this significant general observation: "There can be no doubt that the arrival of birds with us depends upon the temperature and probably upon the winds. With the advance of a low cyclonic center from the southwest, bringing high temperature to western New York in March, April or May, there is sure to be a bird wave which corresponds in magnitude to the warm weather wave which undoubtedly brought it. Many facts seem to show that the birds of western and northern New York are mostly immigrants from the southwest, and the warm weather as well as the prevailing winds of this region also come from that direction. The warm weather at least furnishes the favorable conditions which induce them to migrate. These are no more an agreeable temperature than an abundance of food and favoring winds to aid their arduous passage".

Smith (1917) remarked that "there seems to be ample justification for the statement that in Central Illinois there is a high degree of correlation between the flights of night migrants [in spring] and the meteorological conditions involved in the near approach from the West of an area of low barometric pressure with the accompanying rise in temperature and southerly winds". Possibly with an eye to more general application, Smith (1918) repeated this statement, but without mention of central Illinois.

For the period 1919–1937 there is surprisingly little to be found on this aspect of migration

in the North American literature. The pressure-pattern relationship is given virtually no consideration, while winds, *per se*, unless exceptionally strong, are generally regarded as having little or no relation to time or direction of migration, the latter conclusion being reached chiefly on the basis of local observations rather than from a survey of the meteorological picture for the continent as a whole.

The question arises: why has the whole subject involved in these published findings been, until very recently, so largely overlooked? In the opinion of the authors, at least three factors appear to have contributed to this situation. First, numerous professional ornithologists were interested in the physiological mechanism which induced the state of unrest which, in turn, appeared to precede and accompany actual migration. Thus, experimental investigation tended toward such research as that carried out by Rowan (1929 *et seq.*) and Kendeigh (1934) on climatic factors. Second, while over 40 years ago Wood (1906: 156) remarked that "... enough study of the weather maps has been done at this Museum [University of Michigan Museum of Zoology] to show that 'bird waves' can be predicted with some certainty", the amateur field ornithologist was neither equipped with, nor educated in the use of, meteorological maps to employ the above discoveries to advantage in his avocation. Nor, as pointed out above, was he encouraged by the literature of the day to support Wood's views. Third, the science of meteorology itself is greatly advanced today in knowledge, techniques and availability over what it was during the years preceding World War II.

European References

This paper is concerned primarily with the region of North America east of the Rocky Mountains. However, it appears worthwhile to consider whether the type of pressure-pattern first outlined by Cooke favors spring migration elsewhere in the Northern Hemisphere. There is evidence from European findings, for example, to support this contention. As early as 1832, Nuttall (1832: 27) wrote interestingly of an instance of the arrested wave in the Mediterranean region in which adverse winds precipitated numbers of migrant Quail on Islands of the Archipelago, "where they wait, sometimes for weeks, the arrival of a propitious gale to terminate their journey. . . ."

Walter (1908: 365–6), in discussing a paper by Marek of Hungary, stated that Marek had compared "known migrations of the woodcock in Europe with the weather charts of the same dates and had found that, aside from minor deviations, these birds migrate from anticyclonic areas of high barometric pressure to cyclonic areas of low barometric pressure".

Eagle Clarke (1912) devoted considerable attention to "the meteorology of bird-migration", with particular reference to the British Isles and Western Europe. Due perhaps to the moderating climatic influence of warm ocean currents, migration flyways appear to be more complex there than in eastern North America, with considerable west-east spring movement in evidence as well as south-north flights. Nevertheless, Clarke showed that favorable conditions for south-north flights to and through Great Britain and neighboring regions of the Continent of Europe are such that there is a "High" to the east or southeast of these areas and a "Low" to the west or northwest of them. He used maps of barometric pressure to illustrate favorable and unfavorable conditions. He believed that the clear weather of a high pressure system prevailing in the area in which the movement has its origin is a prerequisite to the great "rushes". However, in regard to winds, he took a strong position later echoed by numerous other writers on the subject: "... Their direction, apart from the weather condition to which they are due, has no influence whatever on the [migratory] movements".

Thomson (1926), in reviewing European findings to that date, stated Clarke's views and summarized the work of 2 meteorologists, Hegyfoky and Defant. Hegyfoky found spring migration into Hungary "favored by high barometric pressure and rising temperature in the region passed through, these conditions being commonly present when there is a depression

over northwestern Europe". Similarly, Defant found "a close correlation . . . between [spring] immigration into Austria and high barometric pressure over the Balkan peninsula"; but, while he recognized the attendant existence of a pressure gradient falling from east to west in the Mediterranean region, he did not emphasize the importance of the northwestern depression. After noting that the correlation with a high pressure area was similar to that found by Clarke, Thomson is then careful to say: "Defant, however, differs from Eagle Clarke in attaching direct importance also to favorable winds".

Thomson (1936), reviewing subsequent (1926–1935) findings on weather influences, quoted Schenk who, following up Marek's earlier work, investigated the spring migration of the Woodcock (*Scolopax rusticola*) into Hungary in relation to weather conditions. "He [Schenk] found that the chief movements coincide with, or quickly follow northwesterly cyclonic conditions (depression in the region of England), possibly because there is then fine weather (with warm air currents from the south) over the Mediterranean."

While further investigation was carried on in Europe, notably in Finland by Palmgren (1937), the tendency has been to deal with aspects of migration outside the immediate scope of this paper.

Recent North American References (1938–1948)

During recent years improved U. S. Weather Bureau maps became available to the North American public, and certain newspapers began printing simplified versions of such maps. Some radio stations issued not only weather forecasts, but also detailed descriptions of prevailing pressure-patterns and the various meteorological factors involved. Finally, quite a few ornithologists received meteorological training during the course of their World War II service. Thus new availabilities and techniques paved the way for the rediscovery of earlier findings and permitted their practical application. The forerunner of this trend may be said to be McMillan (1938), who brought a new and refreshing outlook to the subject. An experienced airline pilot well versed in the latest meteorological techniques of the day, he emphasized the fact that wind and temperature conditions at ground level may differ widely from those prevailing at the levels of flight; hence, conditions aloft must be considered in any true picture of migratory flight.

He further propounded "the general hypothesis that, whenever possible, migrating birds ride the wind" and that by utilizing "the spinning cyclonic and anti-cyclonic areas" (i.e., Lows and Highs) they "are riding the natural fly-ways of the world". This concept has found more recent expression in Landsberg (1948: 709), who says: "To the meteorologist, it looks as if some . . . migratory birds had developed a rather remarkable system of what is called in modern aviation 'pressure-pattern flying'. This is the system which takes advantage of the maximum possible amount of tail wind in long-distance flights. . . . If powerful modern aircraft, for reasons of economy and safety, adopt the system of pressure-pattern flying, it seems reasonable that birds, which are much more dependent upon assistance offered by these air currents, would follow the path of least resistance."

While we agree with the suggestion that many migrants avail themselves

of "pressure-pattern flying", the following statement by McMillan (1938) appears to be somewhat of an over-simplification: "Spring and the birds came early in 1938. Was one the cause and the other the effect? Why not say that both are effects of the same cause—that the influx of tropical air came early this year? The birds migrate and the wind migrates. . . ." This seems to be a confusion of short-term meteorological factors with longer-term climatology. For example, similar barometric patterns may occur in the eastern United States in November and March, both of them producing an influx of warm, southwesterly air, but only in March do these patterns coincide with a northward flight of birds.

In the region of the states bordering on the Gulf of Mexico, where the influx of tropical air first makes itself evident, interesting facts came to light more or less as a by-product of the recent studies of migration routes in the region of the Gulf. Burleigh (1944: 337–8) pointed out that spring migrants were observed along the Gulf Coast of Mississippi only when grounded by inclement weather. This point was treated more fully by both Williams and Lowery. Williams (1945: 108) indicated that few or no migrants are to be seen on the Gulf Coast in fine spring weather, but the "sudden appearance of the migrants will occur (and occur invariably) *at any hour of the day when bad weather comes.*" Lowery (1945: 92) said: "During clear weather, trans-Gulf migrants that do not breed on the Gulf coast or in the lower Mississippi River valley proceed inland several hundred miles before coming down. That stretch of coast which one might suppose to be teeming day after day during the spring with multitudes of migrants . . . is, in actuality, *during fine weather*, an 'ornithological vacuum' so far as many migrants are concerned. . . . *During inclement weather*, however, all trans-Gulf migrants are precipitated on the first available land. . . ."

That this "bad" or "inclement" weather in fact represented the arrival of a cold front from the northwest was amply demonstrated by Lowery (1946: 178) who described in careful detail the sequence of meteorological and ornithological events which take place when a cold front cuts off the influx of tropical air and grounds northbound migrants. Both Williams and Lowery are describing extreme examples of the arrested wave. It is interesting to compare these descriptions with the example quoted earlier from Nuttall (1832) regarding migrant Quail in the Mediterranean region.

In regard to the northward departure of migrants from the Gulf states, Lowery (1945: 97) stated: "Migrants which arrive on the Gulf coast are not so completely fatigued as to require long periods of rest before advancing northward. . . . Should the weather clear on the morning following the passage of a polar front, the concentrations are usually maintained throughout the first day. On the second day, however, only a few are found. . . ." This statement is of particular importance since it permits the determination of the

barometric pressure-pattern characteristic of the onrushing wave at the inception of its northward movement from the Gulf states. Thus, with the eastward passage of the High, whose leading edge was represented by the cold front, the situation gradually becomes more favorable for the resumption of a northward flow of tropical air. When the High is supplemented by a Low originating over the southwestern states and moving northeastward, then the influx of tropical air over the eastern part of the United States is greatly intensified, and, as determined by observers working independently in the north-central and northeastern United States and southern Canada, it is under these conditions that bird waves may be expected in their regions.

For example, in following such movements in New Jersey, one of us (Wolfarth) observed as early as 1940 the favorable influence of a High centered off the Middle Atlantic coast. The relation between this observation and Lowery's (1946) is apparent, since they both look to a pressure-gradient falling from east to west to accompany northward movement. Similarly, on the basis of her own ornithological and meteorological observations, begun in 1946 at Two Rivers, Wisconsin, another of the present writers (Smith) deduced that noteworthy spring migration may be expected in a given area when that area is, or was during the preceding night, in the warm sector of a Low.

From his own observations in Massachusetts in 1947, coupled with migration data contributed by other observers, Bagg (1948: 147), stated that spring migration into New England and adjacent sections of the northeastern states is stimulated by a pressure-pattern in which "high pressure is moving eastward off the southeast U. S. coast, while a low pressure area is moving into the Great Lakes region after having originated in the vicinity of Kansas and Colorado", the clockwise effect of the High having set in motion a northeastward flow of tropical Gulf air, that flow being subsequently intensified by the counter-clockwise effect of the Low.

Gunn (1948), studied the relation between pressure-patterns and records of migration at Point Pelee for the years 1937–1947 and found that the type of pressure-pattern favorable to New England was equally favorable to the Lake Erie region. Crocker and Gunn (MS.), studying in some detail the meteorological background of the exceedingly early arrival of a wave of insectivorous migrants observed in the Lake Erie and Western Lake Ontario region during the period April 5–7, 1947, attributed the arrival of the wave in this region to the intense cyclonic disturbance which arose in the southwestern states and whose center passed to the northwest of the region, as was first suggested by Mayfield (1947: 153–154).

One consequence of this varied, independent research has been the pooling of ideas and observations by the co-authors that made possible the joint study of spring migration in 1948 along a broad front. It also brought about a search of the literature resulting in the historical background for the subject, as

outlined above. Since each and every one of the references quoted appears to represent an individual approach to the same fundamental principles regarding the relationship between barometric pressure-patterns and spring bird migration, and since these principles are supported by meteorological and ornithological data obtained during the spring of 1948, it is therefore deemed possible to draw up a working hypothesis for the analysis and prediction of spring migration flights.

Hypothesis

1. In the region under consideration, northward movement of migrants in late winter and spring will normally begin under conditions of a barometric gradient falling from east to west and of southerly winds typical of the westward portion of a high pressure area (clockwise circulation) moving off to the east or southeast.

2. When the high pressure area is supplemented by a low pressure area (counterclockwise circulation) originating in the southwest and moving northeastward, the influx of warm, moist tropical air is extended and intensified; concurrently, the northward movement of migrants assumes the proportions of a pronounced onrushing wave in the warm sector of the low pressure area.

3. The intensity of the onrushing wave and the distance advanced by it are likely to be proportional to the depth of the Low and the extent of its northeastward progress.

4. Expressed in terms of "fronts", it may be said more simply: during the period of spring migration, pronounced movement will take place into or through a given region during the interval between the passage of a warm front through that region and the subsequent arrival of a cold front.

5. Cloudiness and rain are likely to be encountered by the onrushing wave as the cold front approaches from the west or northwest. If still in motion when overtaken by the cold front, the onrushing wave will be grounded and thus form an arrested wave until the meteorological cycle is complete and a further advance takes place.

6. An onrushing wave may also be grounded if it encounters a quasi-stationary front intersecting its line of flight.

7. The above relationships, while always of major significance in spring, may be less absolute in character during the later part of spring migration than during the earlier part.

Something should be said concerning the species of migratory birds to which this hypothesis directly applies. Studies so far have shown that a great many migrants do fit into this category and moreover, have failed to indicate any exceptions, although research is needed to determine the exact meteorological factors involved in the spring migrations of certain groups of birds such as: owls; pelagic birds; shore-birds that are chiefly littoral in their passage; other

species, like the Evening Grosbeak (*Hesperiphona vespertina*), whose spring migration may not follow the general south-to-north trend. While recognizing the possibility of such exceptions as these, the authors believe that the above hypothesis does apply to the vast majority of spring migrants in the region considered.

While this paper has been confined to spring migration, because it is felt that autumn migration requires a separate study, the authors concur with the recent statement by Landsberg (1948) that any hypothesis of bird migration "should include a very careful analysis of . . . patterns of atmospheric currents."

To illustrate the relation between barometric pressure-patterns and spring migration in eastern North America, the authors chose one of several periods of notable migration observed in the northern states and southern Ontario during the spring of 1948: April 18–22. This particular example was selected because the favorable pattern affected in succession from west to east all regions that the authors had under personal observation. The authors would add, and emphasize, that while the following example involves only one 5-day period, neither the evolution of the barometric pressure-pattern nor the accompanying evidences of migration differ fundamentally from what the authors have found in other situations that they have studied individually. To cite one case, Bagg's faith in the above hypotheses is based on his studies of the meteorological backgrounds of the following occasions of either notable influx or diurnal migration at Holyoke, Mass: March 25, April 6, 12, 27, May 12, 1947; March 16, 22, April 20–21, May 10, 1948; March 22, 27, 1949.

The figures (1–2) represent simplified versions of the U. S. Weather Bureau 1.30 A.M. and 1.30 P.M. maps for the period of April 17–21. For the sake of clarity, the data on these figures are confined to simple indications of: (1) the positions of the High and Low centers at the particular times involved; (2) their attendant frontal systems; (3) general trend of wind direction (large arrows); (4) a few of the isobaric lines, connecting localities of equal barometric pressure, to indicate not only the positions, but also the general outlines, of the Highs and Lows; (5) the path of the Low center on April 20–21, its position at six-hour intervals being denoted by the dark squares.

April 17, P.M.: High pressure is centered over the eastern Great Lakes with northerly winds prevailing on its eastern periphery, the leading edge of cold air moving southward through Georgia. The clockwise flow of air around this High is bringing southerly winds, and a warm front, to the Prairie states.

April 18, A.M.: The High center has moved eastward to New York and southern New England, the dotted line on the figure indicating the southerly limit of freezing temperatures at 1.30 A.M., E.S.T., on this date.

April 18, P.M.: The High center is moving off the southeastern coast of New England, and the pressure gradient falls from this center along an east-west line through the eastern half of the U. S. to a shallow Low over Nebraska. A warm front is entering Wisconsin.

April 19, A.M.: The High is centered just east of New England. The Low over Nebraska has deepened, and the warm front now extends from northern Wisconsin to Lake Ontario. The warm sector, behind this front, includes the vicinity of Two Rivers, Wis., and the greater part of lower Michigan.

At Winghaven, located on the west shore of Lake Michigan, 10 miles north of Two Rivers, Wisconsin, the day of outstanding migration during April, 1948, was the 19th (Smith). Eight new species for the year were listed on this date

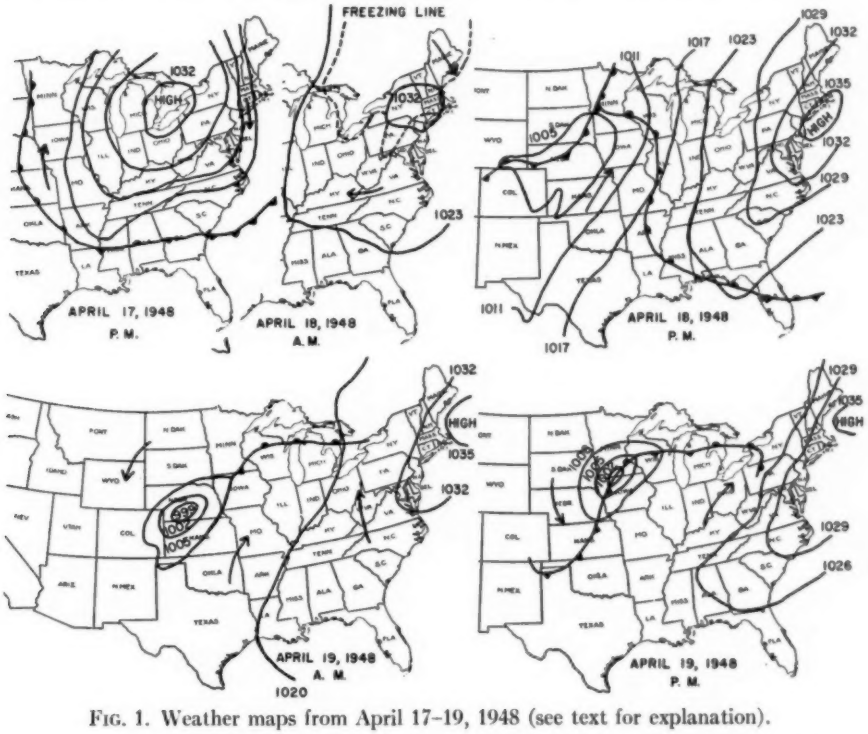

FIG. 1. Weather maps from April 17–19, 1948 (see text for explanation).

—Double-crested Cormorant (*Phalacrocorax auritus*), Shoveller (*Spatula clypeata*), Cooper's Hawk (*Accipiter cooperii*), Ring-billed Gull (*Larus delawarensis*), Bonaparte's Gull (*Larus philadelphia*), Barn Swallow (*Hirundo rustica*), White-throated Sparrow (*Zonotrichia albicollis*), Swamp Sparrow (*Melospiza georgiana*); 3 other species appeared in greater numbers—Blue-winged Teal (*Anas discors*), Redhead (*Aythya americana*), Canvas-back (*Aythya valisineria*). In Michigan, Wallace and Black (1948: 161) reported: "Over the first part of the month of April birds trickled in rather gradually, but a warm spell on the 19th and 20th speeded things up. . . ."

April 19, P.M.: The High is virtually as before. The Low center has moved to a position over the Minnesota-Iowa border, and the warm front has passed to the northeast of Toronto, placing the latter within the warm sector.

April 20, A.M.: High pressure prevails over the Atlantic seaboard, while the Low is now centered over northeastern Wisconsin. From this center, a warm front curves NE to Georgian Bay and then SE to New York City, and is about to penetrate New England.

At Toronto, the morning of the 20th produced a very pronounced influx of migrants, the best of the month (Gunn); 3 new species were noted—Upland

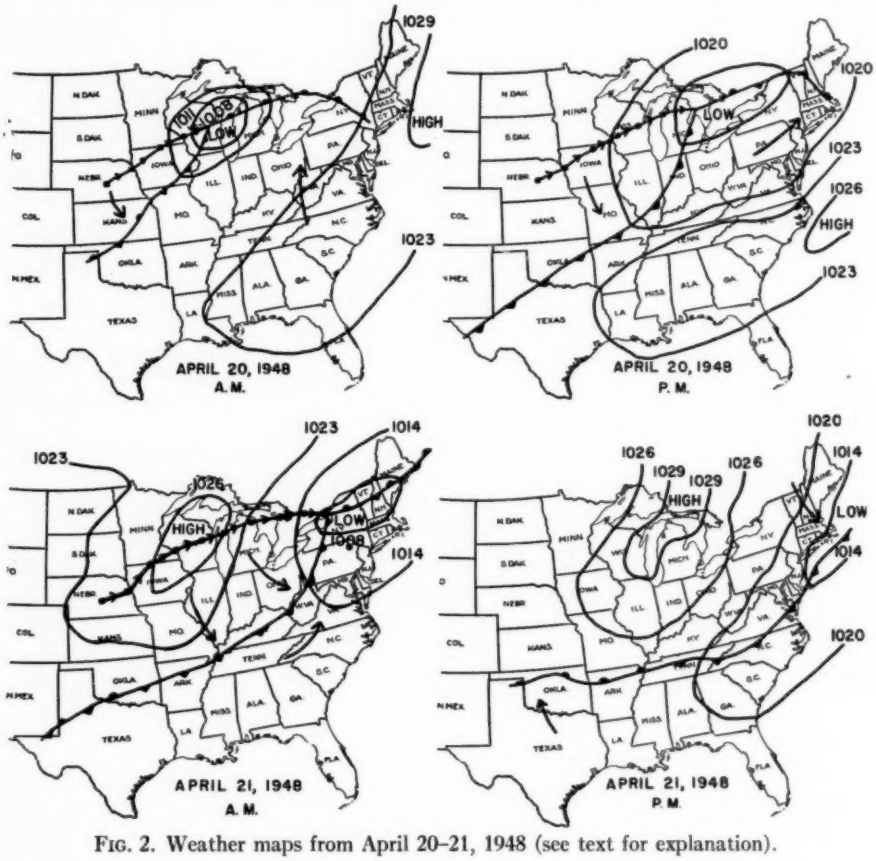

FIG. 2. Weather maps from April 20–21, 1948 (see text for explanation).

Plover (*Bartramia longicauda*), Tree Swallow (*Iridoprocne bicolor*), Brown Thrasher (*Toxostoma rufum*),—and a marked increase in Hermit Thrushes (*Hylocichla guttata*), Golden-crowned Kinglets (*Regulus satrapa*), Savannah Sparrows (*Passerculus sandwichensis*), and White-throated Sparrows. To summarize the Toronto situation, R. M. Saunders reported (*in litt.*) that, as of May 5, 1948, there had been "nothing like a wave since April 19–20". On April 20 there was a great movement, consisting of many kinds of land birds,

in northern New Jersey and also at Hawk Mountain, Pa. (Wolfarth). In New York City, moreover, this day brought to Central Park the wave of greatest volume recorded up to that point in 1948, consisting mostly of White-throated Sparrows, many Hermit Thrushes, as well as a few Towhees (*Pipilo erythrophthalmus*) and a Northern Water-thrush (*Seiurus noveboracensis*) (Nichols). This same day, April 20, brought the greatest wave of the month to the Connecticut Valley in Mass., the significant features being good numbers of Myrtle Warblers (*Dendroica coronata*), Palm Warblers (*Dendroica palmarum*) and Ruby-crowned Kinglets (*Regulus calendula*), plus a good many Chipping Sparrows (*Spizella passerina*), White-throated Sparrows and Pine Warblers (*Dendroica pinus*) (Bagg).

April 20, P.M.: The High is now centered east of the Middle Atlantic seaboard, approximating the quasi-permanent "Bermuda high" of summer, while the Low center has moved to Lake Huron. The warm front extends from northern Vermont to Boston, while the cold front extends southwestward from the Low center.

April 21, A.M.: The Low center has moved to northern New York. A new High, moving down from the Northwest, is centered over Wisconsin. Warm, southwesterly conditions continue within the sector formed by the quasi-stationary front extending from the eastern end of Lake Ontario to the Bay of Fundy and the cold front curving southwestward from the Low center.

In the early morning of April 21 there was migration in New Jersey and Pennsylvania (Wolfarth); in New York City, White-throated Sparrows and Towhees reached their maxima for this wave, but the Hermit Thrush had fallen off in numbers (Nichols). At Talcott Mt., Conn., and Mt. Tom, Mass., the best hawk flights of the month occurred in the final 2 hours of the warm sector, which ended there with the arrival of the cold front in the late forenoon (Bagg). On April 21, moreover, eastern Massachusetts experienced a wave, including 125 Hermit Thrushes listed at Nahant (Alexander et al., 1948).

April 21, P.M.: The Low is now centered east of New England, and its attendant cold front extends from the Atlantic Ocean through Virginia, North Carolina and Tennessee. The new High prevails over the Great Lakes region, while a new warm front is moving northward through Oklahoma and Arkansas. The cycle which began on April 17 is now complete.

The 250 Palm Warblers and 1500 White-throated Sparrows which were observed in 2 eastern Massachusetts localities, Wayland and Nahant, on April 22, (Alexander et al., 1948) appear to represent migrants which entered Massachusetts during the favorable period of April 20–21, were grounded by the cold front on April 21, and then proceeded to concentrate in such areas as Wayland and Nahant, presumably remaining until the next period favorable for further migration (Bagg).

Summary

This paper studies barometric pressure-pattern factors which particularly stimulate spring migration in North America east of Long. 100° W. and south of Lat. 50° N. A distinction is made between an onrushing wave of birds actively migrating and an arrested wave of grounded migrants.

Early North American references (prior to 1938), together with European findings of the same period, are cited to show what was written regarding the relation of barometric pressure-patterns to spring migration before meteorologists recognized the roles of air masses and frontal systems. These early investigations indicated that northward migration occurs in certain regions in the Northern Hemisphere when the pressure gradient falls from east to west.

Recent North American investigations (1938–1948) are described. The basic agreement prevailing among all investigations, both early and recent, leads the authors to propose several hypotheses. The most fundamental of these states that, during the period of spring migration, pronounced movement will take place into or through a given region during the interval between the passage of a warm front through that region and the subsequent arrival of a cold front.

To illustrate the mechanics of this basic hypothesis, the typical period of April 17–22, 1948, is analyzed meteorologically and ornithologically. A notable influx of migrants, which became apparent progressively eastward from Wisconsin to Massachusetts, is directly correlated with the advance and frontal development of a Low center which moved from Nebraska to the New England coast.

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LIFE MEMBER

DR. CLAYTON G. RUDD, a successful dentist of Minneapolis, has long been deeply interested in nature photography and conservation. During his early boyhood in the unspoiled prairies of western Canada he had unforgettable experiences with migrating and nesting waterfowl—among them Whooping Cranes. After graduating in dentistry at the University of Minnesota he moved to Minneapolis; but since 1932 the Teton wilderness of Wyoming has continued to lure him summer after summer, and in 1948 he finished a home near the village of Moose, in Jackson's Hole. His colored motion and still pictures, many of which are notable for their beauty, are principally of Wyoming birds, mammals, plants and scenery.

THE WING MOLT OF THE BOB-WHITE

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CONSIDERABLE interest has recently developed in the determination of age in juvenile gallinaceous birds by the measurement of the length of the growing replacement-primaries during the postjuvenal molt. Knowing the age at the time of collection or observation, then events in the nesting phenology can be dated (Thompson and Taber, 1948; Thompson and Kabat, 1949). Such facts provide a basis for comparing nesting seasons between years and between areas, they facilitate productivity analysis, and they may reveal relationships with other characteristics of the population (such as density and sex and age ratios) and with other environmental conditions.

Since the accuracy of the wing-molt technique of aging depends on the uniformity of the postjuvenal wing molt, there would seem to be a need for further analysis of this uniformity in wild birds. This paper attempts to present such an analysis and a discussion of the irregularities that may be encountered for the juvenile Bob-white (*Colinus virginianus*), and, further, it supplies a discussion of the parallel molt of primaries occurring in the adult during the postnuptial molt.

Normally the juvenile Bob-white commences the postjuvenal primary molt at 28 days of age (Petrides and Nestler, 1943). At this time the juvenal primaries have all developed except the outer 2, IX and X, which are still growing. The process of shedding and replacing these juvenal primaries progresses from the innermost primary (I) distally through primary VIII which completes its growth at 150 days of age. Juvenal primaries IX and X, which have completed their growth at 63 and 65 days of age, respectively, are retained until the postnuptial molt of the following year. This retention was first described by Dwight (1900). The constancy of the rate of this wing molt, according to Petrides and Nestler (1943), who have given the above description, provides the most accurate method available at present for determination of the age of juvenile Bob-whites up to 150 days of age. Their table (p. 779) gives the lengths of the various developing primaries for each day of age from 24 to 150 days.

Little has been written about the molt of quail that are over one year old. Bent (1932) implies that a primary molt occurs in adults by referring to the postnuptial molt as "complete". He also refers to the time of the molt in the statement: "The first postnuptial molt, the following summer and fall, chiefly in September, is complete and produces the adult winter plumage. Adults then continue to have similar molts each year, a very limited head molt in the spring and a complete postnuptial molt from August to October" (p. 17).

This study was supported in part by a grant-in-aid from the Wisconsin Alumni Research Foundation (initially made to the junior author at the Univ. of Wis.) and by Wisconsin Pittman-Robertson Projects 2-R, 14-R and 9-R (which subsequently carried the bulk of the project to completion). The writers are indebted to Dr. Rudolph Bennitt for making available supplementary quail wings taken in Missouri. Acknowledgement is expressed to Dr. J. J. Hickey for his careful examination of the manuscript.

Materials and Methods

Bob-white have been collected periodically in Wisconsin since 1943 with mass collections being made in the autumns of 1947 and 1948. Some additional material was obtained by soliciting quail hunters for wings from shot birds. All materials thus assembled were obtained during the period October 1 to December 10 of each year. Winter trapping of quail provided supplementary material which is described later in the paper. An examination was also made of 97 wings selected from a group furnished by the Missouri Cooperative Wildlife Research Unit.

In the course of the Wisconsin collections, data were recorded on covey size and location, and weight, sex, and age data were taken on individual birds. On each wing the length of each of the developing primaries was measured in millimeters from the point of insertion of the primary in the manus out along the vane of the feather to the tip. This was considered to be a more accurate and more easily replicable method of measurement than that used by Petrides and Nestler (1943) who made their measurements from the leading edge of the wing. To equate our measurements with theirs a correction of 12 mm. was added to ours to compensate for the width of the manus. Thus a measurement of 52 mm. from the point of insertion to the tip of the feather corresponds to a length of 64 mm. when measured from the leading edge (cf. primary II, Fig. 1).

Uniformity of the Postjuvenal Primary Molt

Petrides and Nestler (1943), in deriving their table showing ages corresponding to various lengths of developing primaries, made daily measurements on a pair of quail raised in captivity. These were supplemented and modified by periodic measurements on 7 groups of birds which were raised in captivity and whose ages were known. These 7 groups each contained 10 to 35 birds, whose age at the time of measurement varied from 45 to 128 days. One to 3 developing primaries were measured on each individual. (Thus in Fig. 1 two postjuvenal, or first winter, primaries are in a developmental state, II and III. Primary I has completed its growth.) The mean lengths of the various developing primaries for each of the 7 groups thus provided check points for the table and enabled modification of the daily measurements on the pair to be made.

Errors in age determination were evaluated from the groups by comparing

the lengths of primaries on all the individuals with the modified measurements on the pair of birds. Thus a bird in the 70-day group may have had a sixth primary replacement whose length was 24 mm., rather than the 41 mm. length which is the average length of the sixth primary in the 70-day group. Since 24 mm. correspond to a length characteristic of birds 66 days old, according to the modified measurements on the pair of birds, the error in age determination would be 4 days if age determination were based on the length of the sixth

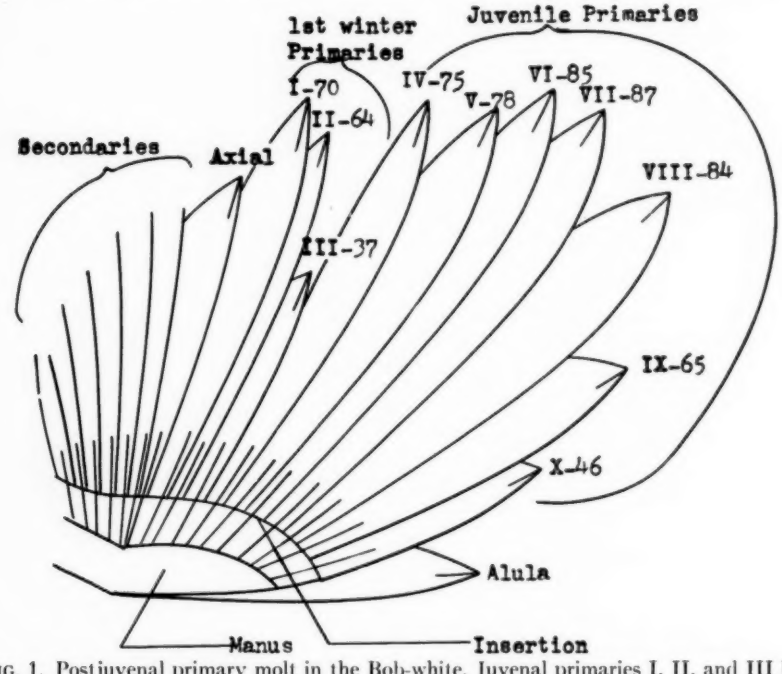

FIG. 1. Postjuvenal primary molt in the Bob-white. Juvenal primaries I, II, and III have been replaced by first-winter primaries. The length of II indicates the quail to be 51 days of age, while the length of III indicates 48 days of age. Numbers are the lengths of the primaries in millimeters found on an actual wing.

primary. The largest error which they found by this method was 13 days, though in some of the groups the maximum individual error was as little as 4 days. The older birds tended to have a larger range of variation between the indicated and the known age than did the younger birds.

These errors led Petrides and Nestler to believe that this method of age determination was limited in its accuracy. Unfortunately they did not give standard deviations of the errors which they found, but these would be considerably smaller than the maximum errors reported.

Inasmuch as the birds used by Petrides and Nestler were 5 or more generations removed from the wild and were reared under uniform conditions in

captivity, the essential uniformity which they exhibited would not necessarily be characteristic of wild birds. Hence, it was felt necessary to evaluate the uniformity of the postjuvenal primary molt as it occurs in wild birds. Because it is difficult to obtain wild birds of known age in large numbers, other approaches must be used for this evaluation. Two alternative methods were employed by us, one based on variation of indicated ages in the same individual, and the other on variation of indicated age within family groups. These do not in a strict sense define the true error in age determination; however, they do provide a valuable delimitation of the uniformity of the primary molt.

The method based on the variation of indicated ages in the same individual can be applied because the age indicated by one growing primary does not necessarily agree with the age estimate from another growing primary on the same wing which is in a developmental state at the same time. This is due to a deviation of the length of one or more of the developing primaries from the lengths listed as characteristic for each day of age by Petrides and Nestler. For each individual wing examined for this study the ages of the quail indicated by each of the growing primaries present were determined from Petrides and Nestler's table. Only birds under approximately 124 days of age were examined, since all primaries except VIII have completed their growth by this age, and hence 2 primaries simultaneously in development cannot be found for comparison of indicated ages.

The difference in the 2 or more age readings for each wing is termed "discrepancy" (Fig. 2), and it is obtained by subtracting algebraically the age indicated by the more distal primary replacement from the age indicated by the more proximal developing primary. An example of this is shown in Figure 1. Here the first-winter primary III has reached a length of 37 mm. The indicated age from this more distal developing primary is 48 days. Primary II, on the other hand, indicates the age to be 51 days, as it is 64 mm. long. Hence the algebraic difference or "discrepancy" is (+) 3 days. It is felt that "discrepancy" is a better term than "error" for the present use inasmuch as the true age is unknown and hence cannot be used as a reference point. The true age in most cases will lie between the 2 indicated ages, especially if the discrepancy is large. Hence the discrepancies are larger than the actual error that would be incurred in aging birds.

The discrepancies arising from each pair of measurements were assigned to an "age class" on the basis of the age indicated by the more distal replacement. The magnitude of these discrepancies in days and the frequency with which they were found in the various age classes are given in Figure 2. An examination of the standard deviations accompanying each age class indicates that up to 75 days of age these discrepancies are small with only 1 case out of 121 showing a discrepancy as great as 6 days. Beyond 75 days of age the discrepancies increase in magnitude, with 14 days being the maximum discrepancy

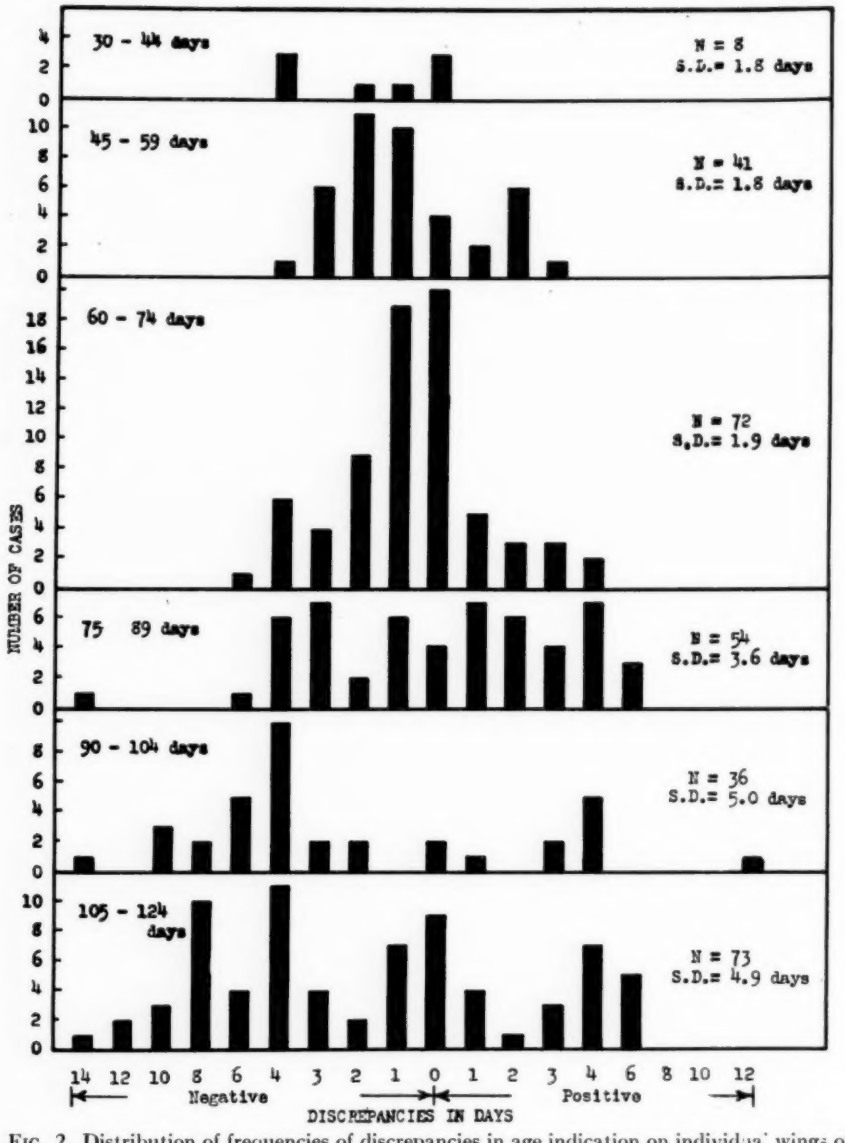

FIG. 2. Distribution of frequencies of discrepancies in age indication on individual wings of quail in various age classes. N = no. of specimens; S.D. = standard deviation.

in any age class. For the entire group of 284 pairs of age estimations here analyzed the number and magnitude of the discrepancies are as follows:

Discrepancies in days....	Negative 14	12	10	8	6	4	3	2	1	0	Positive 1	2	3	4	6	8	10	12
No. of cases.	3	2	6	12	11	37	23	27	43	42	19	16	13	21	8	0	0	1

The standard deviation for the entire group is 3.8 days. However, as indicated above the younger birds show lesser discrepancies, and in practice the age estimate is the average of the estimate from the 2 or more developing primaries. Thus a bird with a discrepancy of 14 days would be assigned an age that is only 7 days from either extreme. For example, if primary VIII indicated 116 days of age and primary VII, 102 days of age, the final age assigned would be 109 days. Even in this case of an extreme discrepancy the final age estimate is almost certain to be within 7 days of the true age. When interpreting the meaning of the standard deviations of the discrepancies, the observer should thus keep in mind the fact that the error in age determination will only seldom be over one-half of the value of large discrepancies. On the other hand, when the discrepancy is small, the error would tend to be more than one-half the discrepancy.

Thus the finding of a small discrepancy does not necessarily indicate greater precision in age determination than does the occurrence of a large discrepancy. The logic of this becomes apparent when it is considered that a small discrepancy is likely to arise through the occurrence of 2 measurements that err in the same direction from the average lengths for the true age, while large discrepancies would be more likely to arise from measurements that err in opposite directions from the average lengths for the true age. Thus an exact value cannot be arrived at, by this means of analysis, for the error in age determination. But it seems justifiable to consider the standard deviation of "errors" would be one-half of the standard deviation of "discrepancies" (3.9) or 2.0 days.

The second method used by us in testing the uniformity of the postjuvenal primary molt was to compare the indicated ages of all juveniles collected from the same covey of quail, and to note the discrepancies between the indicated ages of these juveniles. In general the indicated ages of individual juveniles in a covey fall naturally into one or more groups of ages, because there are 1 or more different-aged broods composing the covey. Thus in a small covey, which may consist of only 1 brood, the indicated ages will usually fall into a single group, whereas in a larger covey, which may consist of 2 or more broods, 2 or more natural groupings of ages may be discernible.

In all the collections and materials gathered for this study 78 of these groupings were apparent, and the total number of birds included in these groupings was 233. Material had to be discarded in some cases where overlapping of indicated ages was possible, as in a covey composed of 2 broods of closely similar age. In such cases it was impossible to assign the intermediate ages to the proper group. It is possible that among some of the groups used in the compilation the extreme discrepancies have been eliminated, since the presence of only one extreme in a group leads to a suspicion that it is a sole representative of a different-aged brood, and hence it was not included. These facts lead to

an artificial bias in the data which would tend to reduce the magnitude of the discrepancies. This may be partially compensated for by some of the groupings

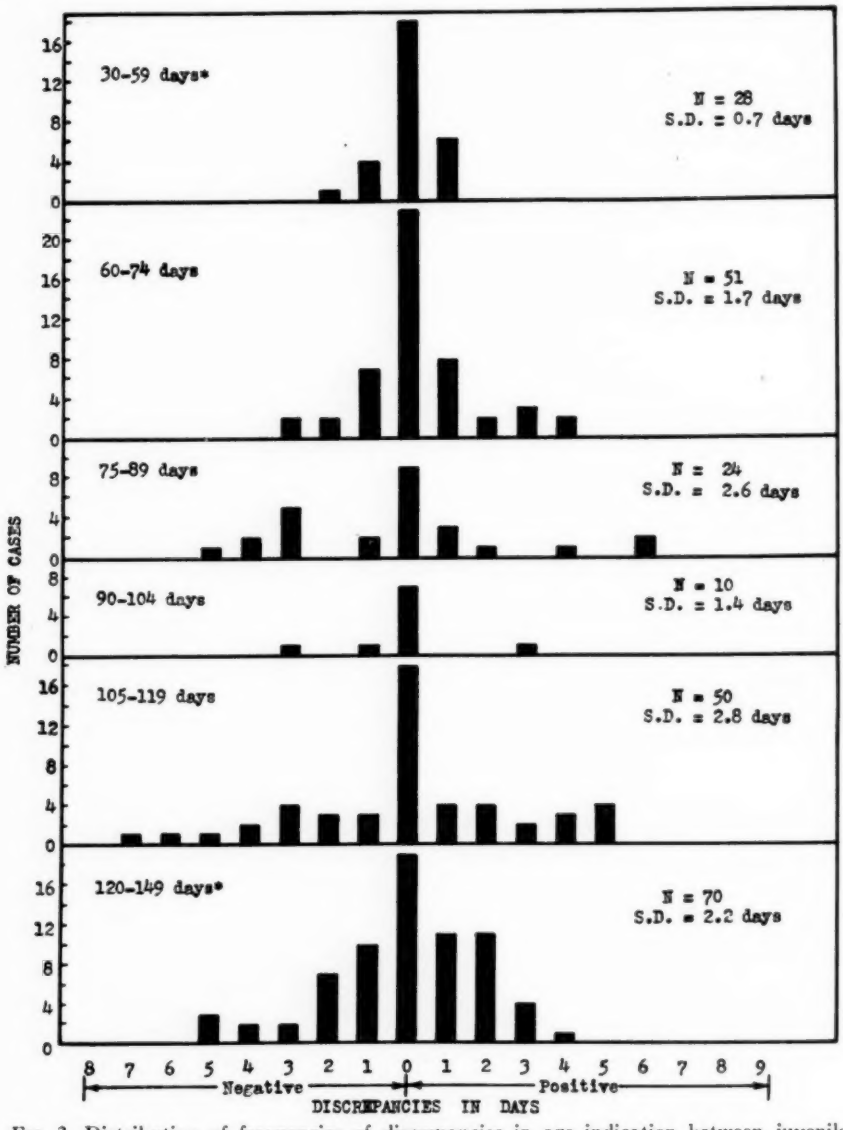

FIG. 3. Distribution of frequencies of discrepancies in age indication between juveniles collected from family groups of various age classes. N = no. of specimens; S.D. = standard deviation. * Note that these 2 age classes have twice the span of the others.

unknowingly including more than one true age of young leading to discrepancies of greater magnitude than actually exist.

Usually only the outermost developing primary was considered in deriving the indicated age of the individual from the table of Petrides and Nestler, though in some cases the average age as indicated by more than one developing primary was used. In compiling the data the mean indicated age was calculated for each of the groups. The departure of the individual indicated ages of birds within each group from this mean were tabulated, and these are termed "discrepancies" as in the previous method. It should be noted that this method differs from the previous in that discrepancies are taken from a midpoint rather than between extremes. Hence the value of the discrepancies are considerably smaller than in the other method. Each group of birds was then assigned to an "age class" according to the mean indicated age of the group, and frequency distributions of the individual discrepancies which were found are given in Figure 3. Again the younger age classes tend to have a smaller standard deviation. The combined data of all age classes embodying 233 birds is as follows:

	Negative								Positive					
Discrepancies in days	7	6	5	4	3	2	1	0	1	2	3	4	5	6
No. of cases	1	1	5	6	14	13	27	93	32	18	10	7	4	2

The standard deviation of this distribution is 2.1 days, and this corresponds very closely with the standard deviation of "errors" (2.0 days) derived by the first method of analysis. Both imply that the maximum error in age determination using the postjuvenal primary molt is probably about 4 days at the 95% level of confidence.

These treatments indicate a relatively high uniformity of the postjuvenal primary molt in the wild Bob-white, and this uniformity is as great or greater than that reported by Petrides and Nestler (1943) for captive birds. Thompson and Kabat (1949) used one-week intervals in plotting hatching dates of Bob-white, and this degree of refinement in age estimation seems well justified by the above considerations.

Irregularities in the Postjuvenal Molt

While the juvenile Bob-white normally molts through primary VIII in the postjuvenal molt, a number of cases have been found where this was not true. During the course of winter trapping of quail, 32 birds were given a special examination in March of 1948. Of the juvenile birds 9 were found to have had an arrested molt. Replacement of only 7 of the juvenal primaries had occurred. The retention of the outer 3 juvenal primaries was evident from the distinctly brownish coloration of these which is a result of fading of the original pearly gray color. The replacement, that is, the first-winter, primaries are relatively unfaded at this time, and under moderately good daylight illumination the contrast with the unreplaced juvenal primaries, which are more faded, is readily apparent. Recognition of the more pointed nature of juvenal primaries (Stoddard, 1931), is not sufficiently reliable for positively detecting the presence of juvenal primaries.

A different line of evidence for an arrested molt was obtained on 15 juveniles trapped alive in early December of 1947. The seventh replacement primaries on these birds were 74 to 98 mm. in length, and the eighth juvenal primaries had not been dropped and were not loose.

According to the table of Petrides and Nestler (1943) the eighth primary should have been dropped when primary VII was 72 mm. long. Confirmation of the arrested condition was later obtained on 5 of these 15 juveniles by retrapping in February. On these 5 birds primary VIII had not been replaced, and the length of primary VII in early December on these 5 had been 74 to 98 mm. This strongly suggests that the other 10 birds which were not retrapped also had an arrested molt, since the lengths of their seventh primaries in early December were of the same order as those on which the arrested molt was confirmed.

On the other hand an examination of 87 juvenile birds trapped during the winter of 1946–47 revealed only 1 bird which had failed to complete the postjuvenal primary molt. This bird had also stopped with dropping and replacement of the seventh primary. Possibly this difference between the 2 years is explicable by 2 considerations. The first of these is that while inconclusive evidence is at hand for the 1946 hatching season, many birds were hatched late in the season in 1947 compared with other years (Thompson, 1949). The other consideration is that the onset of winter was much earlier in 1947 compared with 1946, and this might have induced premature cessation of molting. The birds on which arrested molt was found in 1947 were about 15 to 18 weeks old when trapped in December and hence had hatched in early August.

As could be surmised on finding cases of arrested molt, cases of extension of the molt beyond its normal limits might also be expected to occur. This has been noted for the postjuvenal primary molt in 2 instances: one bird was taken on Nov. 16, 1947 on which the ninth juvenal primary had been shed and the replacement primary was 62 millimeters in length; the other was taken November 6, 1948 with the ninth replacement primary measuring 52 mm. The eighth postjuvenal primaries were completely developed in these two cases. The identity of these birds as juveniles was established by the presence of buff tips on the greater upper primary coverts (Van Rossem, 1925; A. S. Leopold, 1939), and by the unresorbed bursa of Fabricius. Inasmuch as primary VIII completes its growth at about 150 days of age the first of these birds must have hatched before June 9 and the other before June 19.

The frequency with which these irregularities occur is possibly influenced by a number of factors, but as suggested above, a strongly presumptive one is the date of hatching of the juvenile bird. The hatching period of the Bob-white in Wisconsin covers a long span of time, extending from late May to early October. Since primary VIII is normally shed at 101 days of age, this stage may be reached anytime between early September and mid-January. In the case of birds hatching late the onset of winter may terminate the molt before this stage is reached and result in an arrested molt, whereas early-hatched birds may be induced to continue the molt beyond the normal limit by favorable weather. A. S. Leopold (1943) found hybrid and domestic turkeys to be quite variable in the extent of the molt, though no variation was observed among 5 wild turkeys. While he concluded that heterozygosity of the genotype was responsible for this variation, he cites the review by Salomonsen (1939) which strongly suggests that environmental temperatures, by action through the thyroid on the feather follicle, control both the initiation of the molt and its extent. Genetic and environmental mechanisms are not necessarily at odds, of course, as the one may set the stage for the operation of the other.

The Postnuptial Wing Molt in the Adult

The sequence of the wing molt in the adult is very similar to that of the juvenile Bob-white except that it is complete, the primaries being shed and replaced distally commencing with the innermost primary. Inasmuch as the outer 2 juvenal primaries, IX and X, have been retained by the bird through its first year of life, the first postnuptial molt replaces 8 postjuvenal primaries (I through VIII) and 2 juvenal primaries (IX and X).

In the course of obtaining the collections it seemed apparent that a relationship existed between the stage of the postnuptial molt of the adult birds associated with the juveniles and the molt stage of these juveniles. This correlation is difficult to establish with wild birds because of uncertainties in establishing the adult as the true parent of the juvenile. Mere consort is not proof of parentage, since more than one brood may be present in the covey, and nonbreeding adults may also be present. The similarity of the progress of wing molts between adults and juveniles from the same covey arose often enough, however, to lead to further inspection.

A more effective, though less specific, line of approach was adopted to establish this relationship. This entailed a comparison of the wing-molt stages of the adults obtained during the collection period in 1947 with those obtained in 1948. If a correlation exists between the progress of the adult and juvenile wing molt, then the molt stage attained in the adults in 1947 should show a

TABLE 1

Distribution of primary molt stages of adult quail

Year	Sex	Latest primary dropped						
		V	VI	VII	VIII	IX	X	Total
1947	Female	1	1	5		1	2	10
	Male			4	6	7	2	19
	All	1	1	9	6	8	4	29
1948	Female					2	4	6
	Male				2		9	11
	All				2	2	13	17

retardation over those in 1948, since the progress of the wing molt of the juveniles in 1947 lagged greatly behind that of juveniles in 1948.

The lag in the juveniles was due to the lateness of the hatch in 1947 as compared with 1948. In 1947 the median hatching date fell in the first week in August, whereas in 1948 the median hatching date was in early July (Thompson, 1949). Hence many of the adults were occupied with breeding activities until later in the season in 1947. This might be presumed to delay the onset of the molt in the adults and give rise to a correlation of the progress of the adult molt with that of the juveniles. This has been observed in pheasants (Kabat, Thompson, and Kozlik, in press).

Table 1 shows that such a delay occurred in the molt of the adults in 1947 compared with 1948. Of 29 adults in 1947 the median bird had dropped only 8 primaries, while in 1948 most of the adults in the group of 17 birds were regrowing the tenth primary. The table also suggests that the adult males were somewhat in advance of the females in the molt, although the 1948 data are too scant to show this.

In the discussion on irregularities in the postjuvenal molt it was mentioned that unmolted juvenal primaries are distinguishable from the replacement primaries by their faded color. This fading is far more apparent in adult birds that have not completed their molt, since the old primaries have been exposed to fading for a considerably longer time. The fading produces a cocoa-brown coloration which gives an extreme contrast with the pearly gray color of the new primaries. This characteristic of itself may be used as an indicator of adult condition if the molt has not been completed, for once seen it cannot easily be mistaken.

Three cases have been found in which the postnuptial molt definitely did not go to completion. The first of these was a male trapped in early January of 1947. Primary IX was fully regrown, but the old X was retained. On December 13, 1947 a female was trapped and was retrapped on March 10, 1948. In December the ninth primary was 17 mm. in length but was fully grown in March. The cocoa-colored tenth primary remained. In the final case a male trapped on January 7, 1948 had 9 characteristically new, fully developed primaries and a brown tenth primary. In all these cases both wings displayed the same condition, so that the aberrancy was not due to an accident to a feather follicle. These incompletions parallel the incomplete molts discussed previously for juvenile birds, and probably the same factors that terminate molt in the juveniles are operative in the adults.

While successive postnuptial molts, to our knowledge, are essentially the same, the fact that the first postnuptial molt occurs when the quail is a yearling provides an interesting method of distinguishing yearlings and older birds in the adult category. During the first postnuptial molt, in the yearling, the greater upper primary coverts of the juvenile-type are replaced by ones of the adult-type, and the more pointed outer 2 juvenal primaries (which were retained through the postjuvenal molt) are replaced by the more rounded adult type of primary. The adult type of covert is distinguishable by the lack of the buff or mottled tip and also by its tendency to be flatly rounded rather than pointed. In the case of the adult beyond the yearling class the postnuptial molt results in replacement of adult-type coverts and rounded outer primaries. In other words, 2 types of coverts and primaries are present in yearling birds during the course of the postnuptial molt, whereas in older birds only 1 type is present. Since there are only 9 greater upper primary coverts, and the shedding of these precedes that of the primaries by 1 stage, the last one is dropped about the time the eighth primary is shed. Inasmuch as the outer 2 coverts are often more faded and worn and are less buffy than the other juvenile-type coverts, this criterion of yearling condition is almost impossible to apply after the loss of the seventh covert at about the time of dropping of the sixth primary.

One further remark needs to be made regarding the adult-type greater upper primary covert. Typically, it is readily distinguishable from the juvenile-type

covert when comparing adult and juvenile birds in the fall and winter. Without a background of experience, however, there is a possibility of confusing juvenile and adult quail in winter in some cases if the buffness of the tip of the covert is given sole consideration. Out of 22 adult wings given a close examination the coverts of three had a noticeable buffness of tip and seven had a very slight buffness. These might possibly lead an observer to believe that the birds were juveniles. However this tipping of buff on the adult-type covert differs from that on the juvenile type by being of darker hue and by its tendency to be largely marginal rather than "running" down the midrib.

Summary

An analysis of the uniformity of the postjuvenal molt of primaries in wild juvenile Bob-white by 2 independent procedures indicates that the standard deviation of the error of age determination is about 2.0 days. Cases have been found in which the postjuvenal molt of primaries both proceeded beyond the eighth juvenal primary or was arrested with the seventh primary. Adults have also been found with an arrested primary molt. A positive correlation was found between late postnuptial molt in adults and late postjuvenal molt in juveniles. This can probably be ascribed to late completion of breeding activities which delays the onset of the molt in the adults. A method is described for detecting unmolted primaries in both juvenile and adult quail on the basis of the fading of the gray color to brown, and another description enables a distinction to be made between yearling quail and older adults during the postnuptial molt.

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BIRD TRANSECTS ON THE NORTH ATLANTIC

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A TRIP across the temperate North Atlantic or along its coasts offers the opportunity for a type of bird watching known as a pelagic belt transect. Such bird counts serve to increase our knowledge of the spatial fluctuations of avian populations, the normal and exceptional distribution of species, the routes and shifts of range during seasonal periodic migrations, and localizations due to factors of weather, food supply, and current direction.

Four neritic and 2 oceanic belt transects, covering approximately a one-eighth mile swath from the stern or from the bridge deck of a steamer traveling generally at 14 knots, were made between latitudes 44°N and 59°N during August and November 1948. These observations illustrate especially the populations present and the complex of activities during the breeding, post-breeding, early autumnal migration and winter resident periods of the Nova Scotia-Newfoundland coasts, the northwestern and the southeastern Irish coasts, and the North Atlantic between Newfoundland and Ireland. Observations, never interrupted by bad weather, were made at dawn and dusk and through most of the day with time off for breakfast, lunch, tea, and dinner.

Several observations on the neritic transects (table 1) deserve comment. The birds seen in the American coastal zone were migrants, residents, and winter visitants. The coastal birds of Ireland were probably resident there or from Scotland. Fulmars, so evident on the Irish side, were near breeding grounds. Though typically oceanic, they enter the American cool north temperate neritic biochore, where they do not breed, particularly in winter at the Grand Banks, although this is not too evident in the number of individuals recorded in transect 4. One "blue" phase Fulmar was seen off Nova Scotia on November 26 in company with 2 dark phase birds and 15 light phases. Among the diving ducks the Barrow's Golden-eyes and the King Eiders were noteworthy. The location of observation, 2 miles off the point south of St. Johns, Newfoundland, may well be a wintering station for these birds. The absence of reports of diving ducks on the European side was because the ship avoided the bays and estuaries. Although gulls live almost exclusively in coastal areas in winter, a count of 10 species during the November transects is exceptional and probably not to be duplicated anywhere else in an area of comparable extent. With the Iceland and Glaucous Gulls was one gull which followed the ship for about 2 hours after leaving St. Johns and showed light gray wing markings and suggestions of "mirrors"—a Kumlien's Gull I am certain, having previously observed wintering birds so identified on the New

England coast. The observation of so many Brünnich's Murres off Cabot Strait on the northern end of the Grand Banks was a notable sight. Most of them,

TABLE 1

North Atlantic Neritic Transects, 1948

	1	2	3	4
Common Loon—*Gavia immer*				1
Greater Shearwater—*Puffinus gravis*	3			
Atlantic Fulmar—*Fulmarus glacialis*	1	45		18
Leach's Petrel—*Oceanodroma leucorhoa*	39			
Gannet—*Morus bassanus*	3	8	12	
European Cormorant—*Phalacrocorax carbo*		1		
American Golden-Eye—*Bucephala clangula*				70
Barrow's Golden-Eye—*Bucephala islandica*				3
Old-Squaw—*Clangula hyemalis*				8
Eider—*Somateria mollissima*				3
King Eider—*Somateria spectabilis*				4
White-Winged Scoter—*Melanitta deglandi*				5
Surf Scoter—*Melanitta perspicillata*				7
American Scoter—*Oidemia nigra*				30
Oyster-Catcher—*Haematopus ostralegus*		1		
Golden Plover—*Pluvialis dominica*	200			
Ruddy Turnstone—*Arenaria interpres*	28			
Northern Phalarope—*Lobipes lobatus*	50			
Northern Skua—*Catharacta skua*		3		
Glaucous Gull—*Larus hyperboreus*				4
Iceland Gull—*Larus l. leucopterus*				4
Kumlien's Gull—*Larus leucopterus kumlieni*				1
Great Black-Backed Gull—*Larus marinus*	7	4		23
Lesser Black-Backed Gull—*Larus fuscus*			1	
Herring Gull—*Larus argentatus*	2	4	23	66
Mew Gull—*Larus canus*			19	
European Black-Headed Gull—*Larus ridibundus*			3	
Little Gull—*Larus minutus*			1	
Atlantic Kittiwake—*Rissa tridactyla*			10	333
Arctic Tern—*Sterna paradisaea*		1		
Atlantic Murre—*Uria aalge*		1	2	6
Brünnich's Murre—*Uria lomvia*				2500
Dovekie—*Plautus alle*				95
Black Guillemot—*Cepphus grylle*			1	
Atlantic Puffin—*Fratercula arctica*	7			20
Passerine Bird—*Dendroica striata*?	1			

Transect 1. was from Halifax, N. S. to St. Johns, Newfoundland via the most direct route. August 29–30, 1948.

Transect 2. was the northwestern Irish coast from the Vidal Banks to Rathlin Islands. September 4, 1948.

Transect 3. was in the shipping lanes along the southeastern Irish coast in the Irish Sea. November 18, 1948.

Transect 4. was from St. Johns, Newfoundland to Halifax, N. S., the reverse of transect 1. November 25–26, 1948.

being glutted with food, just pattered over the water or "belly-bumped" the surface whenever they tried to fly. The absence of any Razor-billed Auks (*Alca torda*) or of Black Guillemots on the American side is unusual.

The oceanic transects (table 2), detailing the birds seen while traveling over

and back across almost the same 1800 mile route between Newfoundland and Ireland, merit interpretation. Although Atlantic Fulmars are distributed across the ocean in the fiftieth latitude, counts indicate that they prefer the colder waters of the Labrador Current. In the November transect 4 individuals of the birds observed were in the "blue" phase, 1 in the white phase, and upwards of 10% in the dark phase, these latter being all on the American side. The Greater Shearwaters seen in September were in groups of about 20 birds traveling toward the northeast. They were obviously making their journey toward the eastern side of the Atlantic, the western side being vacated by

TABLE 2

North Atlantic Oceanic Transects, 1948

Atlantic Fulmar	384	41	64	52	2	28	60	2000	500
Sooty Shearwater—*Puffinus griseus*	2								
Audubon's Shearwater—*Puffinus lherminieri*								1	
Greater Shearwater	635	227	4			3			
Leach's Petrel	129								
Gannet	1				1				
Ruddy Turnstone			2						
Northern Skua		2			1	2	1		
Pomarine Jaeger—*Stercorarius pomarinus*	1								
Parasitic Jaeger—*Stercorarius parasiticus*	7								
Atlantic Kittiwake	1				51	54	20	7	60
Arctic Tern		6	210	1					
Atlantic Puffin							11	2	2
Date	Aug. 31	Sept. 1	Sept. 2	Sept. 3	Nov. 19	Nov. 20	Nov. 21	Nov. 22	Nov. 23
North Latitude	48° 59′	51° 37′	53° 53′	55° 09′	51° 28′	51° 40′	51° 48′	50° 46′	49° 25′
West Longitude	49° 14′	40° 45′	31° 13′	20° 52′	15° 04′	21° 18′	31° 22′	41° 44′	48° 02′
Temperature (F)	56	57	52	56	51	51	52	48	42
Wind	NW	N	N	N	S	SW	E	NW	NW

October. The 3 individuals recorded on November 20 represent a late departure. The Audubon's Shearwater observed on November 22 at 50°46′N40′W in company with hundreds of Fulmars was unusual, since the closest breeding ground is Bermuda. The Northern Skuas, usually solitary, were twice seen in pairs. The single Pomarine Jaeger, easily distinguishable as to species by size alone, was observed in a close flock with 3 Parasitic Jaegers moving southeasterly. During the gale in November one Kittiwake, overturned by an extra gust of wind, flew upside down for five seconds before turning right side up. The Arctic Terns, sometimes calling as they flew along, were for the most part trending in an easterly direction. The Atlantic Puffins, easily overlooked at sea, were over 800 miles from land.

SUMMARY

Observations of the birds of the temperate North Atlantic were made by belt transects during stated periods of a day and month over an arc of sea approximately one-eighth mile from the after-deck or the bridge deck of a ship traveling an average of 14 knots of speed over a known course. The records show 36 neritic species and recognizable subspecies and 13 oceanic species in the late summer and fall of 1948.

THE WILSON ORNITHOLOGICAL CLUB LIBRARY

The following gifts have been recently received. From:

Betty Carnes—1 pamphlet
David E. Davis—4 magazines
Mrs. C. N. Edge—1 book
Fr. Haverschmidt— 1 reprint, 1 book
Leon Kelso—1 pamphlet
Harold Mayfield—1 reprint
Ernst Mayr—1 reprint
Margaret. M. Nice—13 reprints
Mrs. G. W. Nielsen—1 book
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William H. Phelps—2 reprints
Oscar M. Root—1 reprint
W. E. Scott—1 reprint
L. L. Snyder—1 reprint
George M. Sutton—19 reprints
J. Van Tyne—7 reprints
Ralph Wilkinson—1 reprint

WILSON ORNITHOLOGICAL CLUB NEWS

The editors of *Audubon Magazine* have long believed that professional and amateur ornithologists should write popularized accounts of their researches and of conservation problems to arouse greater interest and understanding among people outside the biological field. To stimulate more popular ornithological writing, *Audubon Magazine* is now paying from $15.00 to $75.00 for all accepted articles ranging from 1,500 to 2,500 words, although shorter or longer material may be acceptable. Articles on bird ecology, migration, behavior and food habits, personal experiences in attracting birds, birds and other wildlife of a region, and local wildlife conservation projects are particularly desirable.

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WILSON ORNITHOLOGICAL CLUB ANNUAL MEETING

The 31st Annual Meeting of the Wilson Ornithological Club will be held at Jackson's Mill, West Virginia, April 28–29, as announced in the December *Bulletin*.

If you are planning to attend, please write immediately to Maurice Brooks, West Virginia University, Morgantown, West Virginia, so that he can make arrangements for your accommodations. Please state the approximate time of your arrival and departure, and the names of the persons in your party.

Although Jackson's Mill provides a picturesque, rural setting for this meeting, its accommodations are excellent. The cottages are of substantial, dwelling-house type and every room is heated. This whole establishment is a detached part of the campus of West Virginia University. It is an ideal place for the children of those who wish to bring their families.

GENERAL NOTES

BLACK VULTURES IN WESTERN PENNSYLVANIA

Since W. E. Clyde Todd, in his "Birds of Western Pennsylvania", lists no record of the Black Vulture (*Coragyps atratus*) within his area, and since no subsequent report is on file in the records of the U. S. Fish and Wildlife Service, the following observations are evidence of the further northward spread of this species.

On September 17, 1949, while observing hawk migration from the Cross Mountain fire tower in southwestern Franklin County, my attention was drawn to a bird which had just arrived from the east at a height of 150 feet. The conspicuous white wing patches, short square tail, dark head, and characteristic flight identified it immediately as a Black Vulture. It flew to a dead tree one quarter of a mile south of the tower, and alighted. Six minutes later a second Black Vulture arrived from the east, passed 500 feet overhead, then turned south, and losing altitude in 3 wide circles, alighted in the same tree with the first individual. One then flew to a nearby tree, and both remained perched in full sight for nearly 2 hours. During this time Turkey Vultures (*Cathartes aura*) were constantly in sight, flying, or perched in trees near the Black Vultures; one rested for more than half an hour in the same tree with one of the latter, showing the distinct difference in size between the two. In the afternoon, when Seth H. Low and I were driving through Blair Valley, just across the state line in Maryland, we saw 1 Black Vulture in a roost of more than 50 Turkey Vultures on the west slope of Rickard Mountain, 3 miles east-southeast of Cross Mountain summit.

On the same day, 8 Black Vultures were seen circling over the south slope of Fairview Mountain, Maryland, 6 miles south of Cross Mountain, by Orville W. Crowder and party. Although members of the Maryland Ornithological Society were observing hawks on 9 other ridges between Hagerstown and Grantsville that day, no other Black Vultures were identified.—CHANDLER S. ROBBINS, United States Fish and Wildlife Service, Patuxent Research Refuge, Laurel, Maryland.

LARK BUNTING IN CENTRAL OKLAHOMA IN WINTER

During late January and early February of 1949 a series of severe wind, snow and sleet storms swept across Oklahoma from the west. In the wake of one of these a somber little bird appeared at our banding station on the morning of February 5. Although completely out of its normal winter range (Mexico), it was unmistakably a female Lark Bunting (*Calamospiza melanocorys*). The identification was later verified by Dr. W. P. Taylor, leader of the Wildlife Unit at A. and M. College, and O. S. Pettingill of Carleton College, Minnesota.

To our surprise the bunting repeated the same afternoon, again on February 7, 16, 19, 20, 22, several times a day through March 15, 17, 25, 27, 31, April 1, 2, 3, and was back for the last time on April 9. These dates coincide with the repeat records of a flock of Harris's Sparrows (*Zonotrichia querula*) with which the Lark Bunting was seen several times in the fields west of the station; the flock disappeared about the same date as the bunting's final appearance.

Although very similar to the Harris's Sparrows in coloring, the bunting could always be distinguished from a distance by its characteristic behavior. At our approach to the trap the Harris's Sparrows usually flew *up*, flitting from side to side. The bunting always dove *down* into the farthest corner, and continued to push and flutter in one spot until released.

Weights were taken from time to time with a scale accurate to 1/100th of a gram.

Feb. 5 36.72	Mar. 5 38.35	April 2 38.35
Feb. 19 39.32	Mar. 31 35.75	April 3 37.37
Feb. 23 36.40	April 1 37.37	April 9 42.25

FREDERICK M. AND A. MARGUERITE BAUMGARTNER, Stillwater, Oklahoma.

SMITH'S LONGSPUR IN OHIO

On April 18, 1949, G. Ronald Austing, Worth Randle, and I collected 4 Smith's Longspurs (*Calcarius pictus*) from a flock of about 25 longspurs at the Oxford airport, Butler County, Ohio, about 30 miles north of Cincinnati. The flock from which the 4 individuals were collected consisted of about 25 birds, some of which may have been Lapland Longspurs (*Calcarius lapponicus*) since it was not possible positively to identify each bird.

The flock was first seen April 9, 1949, by Austing, Victor Sloane, and me. The birds were wild and at that time were identified only as longspurs. Every effort was made to collect specimens since Lapland Longspurs are very rare in Southern Ohio (there being only 3 records: one collected during the winter of 1869–70 by Dury; one December 11, 1877; and 4 seen December 15, 1946 by Victor Sloane and me). On April 16, Austing, Randle, and I again attempted to collect specimens but with no success. At this time the unstreaked ochraceous-buff breasts of some of the birds were first noticed and these birds were tentatively identified as Smith's Longspurs. On April 18, Austing, Randle, and I again located the flock. Since the birds were reluctant to fly in the face of a 25 to 30 mile per hour wind accompanied by sleet and snow we were able to come within range.

Four specimens, all males, were collected; 3 are in the collection of the Department of Zoology, University of Cincinnati and one in the Ohio State Museum at Columbus. The specimens all show the buff breast first noticed in the field, being in nearly full breeding plumage.

Smith's Longspur has been definitely recorded in Ohio only once previously: On January 29, 1888, when Clark P. Streator collected 2 specimens from a large flock which were feeding on ragweed near Garrettsville, Portage County, Ohio (see *Ornithologist and Oologist*, 1888, **13:** 95; and *Wilson Bull.*, 1904, **16:** 85). Where these specimens are I do not know. They are not in the Cleveland Museum of Natural History nor in the Ohio State Museum at Columbus. Streator's record was inadvertently omitted by both Lynds Jones and William Dawson from their publications on Ohio birds.—Emerson Kemsies and G. Ronald Austing, University of Cincinnati, Cincinnati, Ohio.

INJURY FEIGNING BY WILLOW PTARMIGAN

During the summer of 1941, at Churchill, Manitoba, I frequently encountered broods of young Willow Ptarmigan (*Lagopus lagopus*) with their parents on the tundra. The excited calls of the parents, or the "broken wing" act if the observer happened to be close, usually indicated that young were concealed somewhere nearby. When the family group was taken by surprise and the parents exhibited this type of behavior, the chicks crouched in the grass or took cover under the nearest object. Whenever broods were encountered, a search for the chicks was made so that they might be banded. The parents, with the female leading and showing the most anxiety, attempted to draw attention away from the chicks, by feigning injury until the searchers had found them. When discovered, the chicks scampered or flew off in several directions, protected by a barrage of flying attacks on the prospective bird bander by one or both parents. Seldom did the adult bird actually strike, but the confusion that accompanied its attack and the scattering of the chicks was so complete that by the time one could collect his wits and stop ducking, the chicks had disappeared from view and were in safe hiding at some distance from the spot. Chicks became such strong fliers after being out of the nest for about a week that once they had flushed, tracking them down was nearly impossible. Even chicks a few days old could fly several yards and then disappear in the tundra growth. To the best of the writer's knowledge injury feigning by this species has not been previously reported.—Oscar Hawksley, Laboratory of Ornithology, Cornell University, Ithaca, New York.

DIVERSIONARY BEHAVIOR OF RED-COCKADED WOODPECKER

On April 26, 1948, Lucien Harris, Jr., John W. Burch, and I found 2 occupied nest holes of Red-cockaded Woodpeckers (*Dendrocopos borealis*) in longleaf pines about 50 yards apart. One of these holes, only 5.5 feet from the ground, is the lowest yet recorded for the species to the best of my knowledge. The young had left both nests by June 13, 1948. On May 29, 1949, I again visited this spot with J. B. McCall, Jr., hoping to have him photograph the birds which occupied the lower nest site. When we had approached within 5 feet of the nest a female carrying food approached; upon seeing us she flew with somewhat impeded flight, stopping at several intervening trees, to the second nest hole 50 yards distant, entered the hole still carrying the food, emerged without the food, and flew away. McCall and I satisfied ourselves that the second nest hole was unoccupied. The visit of the female to the unoccupied hole served effectively to divert our attention from the occupied nest. I left, but McCall remained and was successful in taking excellent color movies of the female feeding the young from a distance of 20 feet within the next half hour. These observations occurred near Kingsland, Camden Co., Ga.—FREDERICK V. HEBARD, 1500 Walnut Street Building, Philadelphia 2, Pennsylvania.

BEHAVIOR OF SPARROW HAWKS

On March 22, 1949 at about 1 P.M., 3 Sparrow Hawks (*Falco sparverius*) were seen flying above and around the roof of the 7-story Department of Justice Building, Washington, D. C., directly across the street from our observation window on the fifth floor of the Internal Revenue Building. One alighted on a chimney on the Justice Building, another about 100 feet distant from the first on a wire attached to the same roof; the third hawk alighted near the bird perched on the chimney. After a few moments the third bird mounted the perching bird, and the two birds apparently copulated; the upper bird was clearly smaller than the other. Within a few minutes both flew away, the larger bird out of sight and the smaller bird directly to a position near the bird perched on the wire. The smaller hawk soon mounted the bird perched on the wire and the 2 birds apparently copulated; again the upper bird was clearly smaller than the other bird. After the second apparent copulation, the smaller bird flew away and out of sight; the larger bird remained perched in the same place. Only 3 birds were involved in the behavior described. About 5 minutes later a smaller sparrow hawk flew to, and mounted, this same perching bird, and the 2 birds apparently copulated. The total elapsed time for all of these observations was approximately 20 minutes.—ARTHUR H. FAST AND LEWIS H. BARNES, Internal Revenue Building, Washington, D. C.

SPARROW HAWK BAFFLED BY ROOFLESS COURT

The skill of the sparrow hawk in flight would seem to assure its ready escape from a roofless enclosure approximately 85 feet high and with an area of 115 x 195 feet. Such an enclosure seemed to offer an insoluble problem, however, for a female sparrow hawk (*Falco sparverius*) which died of starvation and thirst in a court of the U. S. Department of Commerce building in Washington, D. C. This court has no side exits, but is entirely open to the sky.

There was no indication that the sparrow hawk was incapacitated in any way when first observed in the court on July 21, 1949. It flew many times with no difficulty at all from one side of the court to the other, and on at least one occasion ascended to a cornice just one floor below the top of the building. As the hot July days progressed, however, it became less alert and permitted observers at windows to approach within a few feet. On July 27 it was offered a chunk of liver which it accepted and tore with its beak, without eating more than a few shreds if it ate any at all. The next day it disappeared, and the day thereafter, 8 days after it was first seen, it was found dead on the cement floor of a sunken alleyway adjoining the

court. It is my belief, shared by others who saw the hawk, that it somehow became bewildered and unable to recognize that freedom was easily accessible if it flew upward.—Frank C. Cross, 9413 Second Avenue, Silver Spring, Maryland.

SHRIKE ATTACKED BY BARN SWALLOWS

The Barn Swallow (*Hirundo rustica erythrogaster*), though normally a peaceable bird, appears to lack no courage in attacking its enemies. Bent (1942, *U. S. Nat. Mus. Bull.* 179: 452) reported that he once saw a pair of Barn Swallows attacking and chasing a Sharp-shinned Hawk which had approached their nest too closely.

On August 2, 1949, I saw 5 Barn Swallows attack a Migrant Shrike (*Lanius ludovicianus*) near Colesville, Maryland. They harrassed the shrike, which was perched on a telephone wire, until they forced it to take wing and flee across a field with its tormentors in hot pursuit. This attack seemed to be entirely unprovoked; the date was well past the period when Barn Swallows are known to nest in the vicinity. Apparently, they merely recognized the shrike as an enemy and set upon it for no other reason.

Recognition of the shrike as an enemy is evidently not universal among small North American birds. About one month earlier, near Osborne, Kansas, I had seen a Meadowlark (*Sturnella neglecta*) and a Redwing (*Agelaius phoeniceus*) calmly sharing a stretch of telegraph wire less than 6 feet long with another shrike. These 2 species are not listed by Miller (1931, *Univ. of Calif. Pub. in Zool.* 38–2: 198, 200) among the victims of shrikes, but he lists other birds, including the Mourning Dove, Cardinal, Robin, and quail, which are as large or larger. —Frank C. Cross, 9413 Second Avenue, Silver Spring, Maryland.

PECULIAR BEHAVIOUR AT THE NEST OF *FLUVICOLA PICA*

The small white and black tyrant (*Fluvicola pica*), known in Surinam as the Cotton Bird frequents banks of ditches and watercourses and is quite common in the coastal area. It builds its domed nest with a side entrance in branches overhanging the water. At a nest found on July 24, 1946 near Nieuw Nickerie I observed a peculiar behavior of one of the parent birds. The nest was lined with white feathers and contained one egg and one newly hatched chick. The parent birds were not present. I was much surprised to see suddenly one of the parent birds hopping nervously on the branches near the nest with a large white feather in its bill, but it did not actually enter the nest. At this stage of the breeding cycle the lining of the nest seemed quite out of place. So I attribute this behavior as the outcome of nervous agitation caused by my presence, when the bird returned to its nest. It seems to me to be a typical example of a "displacement activity", a behavior so common among birds. Armstrong (Bird Display and Behaviour. 1947) mentions many examples of fidgeting with nest material by birds in a great variety of situations and my observation of *Fluvicola pica* seems to be another example.—Fr. Haverschmidt, Paramaribo, Surinam, Dutch Guiana.

RED-WINGS FEEDING ON WHITE ASH

A review of the literature shows few examples of Red-wings (*Agelaius phoeniceus*) feeding on seeds of trees. Beal (1900, *U. S. Biol. Surv. Bull.* 13: 41) lists "fruits of the wild cherry", beechnuts, and gives a personal account of Red-wings extracting seeds from pine cones, which he considers a case of necessity.

On October 15, 1949, I observed 2 male Red-wings (second year birds) feeding on the seeds of a White Ash (*Fraxinus americanus* L.) near a marsh at Lake Waubesa, Madison, Wisconsin. Both birds remained in the tree for half an hour, during which time they continually seized, manipulated, and dropped ash fruits. At first it appeared that the birds were simply picking off the fruits in play, so quickly did they handle them, but closer examination showed that they

were crushing the fruits in order to obtain the seeds, and immediately dropping those fruits which were not easily opened.

The method by which they removed the seed from the fruit seems interesting enough to be described. The birds seized the fruit with their beaks, pinching the edges of the blade near the distal end of the enclosed seed in such a manner that the fruit split open. Though they generally picked at the fruits from stretched positions, they sometimes carried one to a branch and held it with their claws. It is possible that this method of feeding is a habit of general occurrence. Wetmore (1919. *Auk.* **36:** 190–197) records an equally unusual food-securing technique in the Bronzed Grackle, whereby the shells of acorns were split in two by repeated impressions around the shells from the keel on the palate.—ROBERT NERO, University of Wisconsin, Madison, Wis.

MORTALITY IN MEADOWLARKS AS A RESULT OF SEVERE WINTER WEATHER

In January and February of 1949, in the vicinity of Lawrence, Douglas County, Kansas, there was prolonged sub-zero weather accompanied by sleet and snow. Storms occurred frequently, and the ground surface, particularly in open areas, remained covered with ice which prevented birds from reaching food on the ground. Beginning 3 miles east of Lawrence, birds were observed on a 3.5 mile stretch of highway bordered by cultivated fields and meadows. The observer made a round trip over the highway each day on his way to and from Lawrence. There is an open deciduous forest adjoining the eastern and southern margin of the fields and meadows. There are brush covered hills to the west and fallow fields to the north. In the area studied the Meadowlark (*Sturnella magna*) was the most consipcuous species. In early January several species of fringillids, in company with the Meadowlarks, foraged at the margins of the highway. The snow plow, in clearing ice from the pavement, had left a strip 2 feet wide on the shoulder of the highway on either side of the concrete and it was on this open ground that the birds congregated. With the continued icy conditions, fewer fringillids were seen; many individuals probably retreated to the protected wooded area on the eastern margin of the field. However, the Meadowlarks remained, clinging tenaciously to the narrowly cleared strip.

In early February the Meadowlarks were noticeably weakened, and some individuals on being flushed seemed to have difficulty in flying for a distance of as much as 30 feet. As the days passed there were progressively fewer Meadowlarks along the margin of the highway, and on occasion freshly dead individuals were noted.

A brief search of forested and brushy land bordering the fields and meadows was made on February 20, 1949, but there was no indication that the Meadowlarks had sought food and shelter in these areas. Probably they remained along the roadway in spite of inadequate cover and, I suppose, with a constantly diminishing food supply, with the resulting high mortality. There was no evidence of mortality among the fringillids; these birds seemingly dispersed to more favorable areas. The Meadowlark, according to Grinnell (1928, *U. Calif. Chronicle,* XXX. 429–450), "is equipped to get its food safely and in adequate amount only from ground surface which is open-clothed with a low type of plant cover". The fact that these birds failed to use the adequate food in the adjoining, though ecologically different, habitats is testimony to the limited ecological tolerance Grinnell pointed out.—PHILIP H. KRUTZSCH, Museum of Natural History, University of Kansas, Lawrence, Kansas.

EARLY WOODCOCK NESTING FAILURE

On March 17, 1949, Aiden Ripley advised me that he had located the nest of a Woodcock (*Philohela minor*) with 2 eggs in Lexington, Mass. On March 18th it began to snow in the Boston area at about 9 A.M. and by midnight, when the temperature had dropped to approxi-

mately 10°F in the suburbs, 7 inches of snow had accumulated. On March 19th, a bright day with the temperature approximately 32°F, Ripley and I visited the nest site. There was no Woodcock at the location where Ripley had seen the eggs. However, we finally located, at the base of a 2-inch diameter birch tree, a hollow depression in the snow approximately 4 inches deep, with one egg resting on the snow in the bottom of this depression. The egg was frozen and the shell was cracked. A short way from this depression was a little channel in the snow about 12–14 inches long which indicated that the bird was restless and had left the nest momentarily, stomped around, and then returned. Apparently she had abandoned the nest just before the snow stopped falling March 18th.

Ripley immediately assured me that the 2 eggs had not previously been located at the base of this tree, but had been in a little clearing 2 or 3 feet to the left. We scraped away the snow underneath the depression where we had found the one egg and found the other 2 eggs within 4–5 inches of it, under the snow. During our scraping, one of these eggs was broken; it was not hard frozen. The other was unbroken. Ripley is absolutely certain that the Woodcock had moved the first 2 eggs to this new location, perhaps in anticipation of having to endure the storm, since there was somewhat more shelter at the base of the birch tree.—RICHARD BORDEN, 20 Spruce Street, Boston 8, Massachusetts.

NOTES ON WING-FLASHING IN THE MOCKINGBIRD

For some years before Sutton published his brief paper (*Wilson Bull.*, **58:** 206–209, 1946) on the display by the Mockingbird (*Mimus polyglottos*) which he calls "wing-flashing", this behavior had been very interesting and thought-provoking. Now, certain conclusions have been rechecked by further observation and seem valid enough to set down in writing.

Since June, 1943, it has been possible to watch Mockingbirds nearly any day all year long, at Savannah, Georgia. Some seasons or parts of seasons specific things set the adult birds apart enough so that individuals could be recognized and the sex known. One year the resident male had a lame leg. Another summer there was no male on territory for some weeks, until another bird took up residence. In spring the females arrive in clean plumage and for some time are in contrast to the males with their dirty plumage.

For some time it seemed that the males never used wing-flashing, but at least 3 undoubted instances of male indulgence have been seen; a few other times it may have been a male that displayed. The performance has been seen many hundreds, possibly thousands of times, which indicates that male indulgence is quite rare. The females come on the grass every few minutes when feeding young, and the males nearly as often.

The fact that the male rarely flashes its wings may explain why Sutton at Orlando, Florida, and Mrs. Lasky at Nashville, Tennessee, did not observe the display commonly in winter since the males remain on territory all winter, but the females appear to leave soon after the postnuptial moult in late August or in September. The male is always somewhere around in the winter, but with the gonadal influence low and little need to defend territory he sings very little until about February. In spring a female comes and accepts the territory. In 1945 the female came on April 15, in 1946 on March 31, while in 1948 one arrived on March 28, and was carrying nesting material the next day.

When a brood of young birds follows the parents on the grass, begging for food or learning to catch it themselves, some will flash the wings and others will not. One such brood of 3 which was seen daily for a week, contained 2 birds that did and one that did not display on each occasion when all were present. This is thought to indicate that the sexual differentiation in this particular appears quite early in life.

There seems no portion of the summer season when the females flash their wings any more than at any other time. In other words, there is no waxing and waning as in other behavior

peculiar to the season of reproduction. The behavior was not more common when the male was present. It was not seen in any aspect when it could be thought a part of the relationship between the sexes.

The flashing is performed in many places, on the ground and off it. One female displayed several times on the ground, flew to a stake in the garden and there lifted her wings, then to the top wire of the lane fence and again lifted her wings before leaving. Another bird circled a spot and flashed her wings several times in succession before finding the insect she evidently knew was there. This looked like intentional use, yet I think it purely accidental for she ran on over the yard and caught insects here and there without showing her wings again.

In flashing the wings, the bird stands erect and holds its head high. The young, when begging for food, crouch, extend the wings out and down, quiver, hold their heads down and bills up, and in general fail completely to behave anything like either young or adult in wing-flashing. The posture of the female when ready for copulation resembles the begging of the young.

The only explanation that seems to fit, is that this is a bit of instinctive behavior which has no present use or meaning and which has no adaptive (purposive) value.

In 2 instances only, I have seen the Brown Thrasher (*Toxostoma rufum*) flash its wings in identical fashion, though there have not been as good chances to observe this species.

It is my belief that neither season, temperature, nor the frequency of the feeding trips to the nest, affect the frequency with which wing-flashing is done. It is observed in the shade, in the early spring, and at all times of day in the summer in equal frequency.

Wampole (*Wilson Bull.*, **61:** 113, 1949) tells of a bird making 4-foot vertical flights from the roof of a schoolhouse, and pausing to raise and extend the wings. It may be that this note refers to flight song of the male, a behavior which seems, in this locality, to vary greatly among individuals. In this flight song the male may flit around and do much posturing, but to me it does not seem the same performance as the deliberate wing-flashing which is the subject of this paper. Even though the performance he observed was without song, it may have been the practice of a young male, much like the instance of the very young bird I saw sitting on a fence and practicing a whisper song.

The conclusions from observations of wing-flashing are that it is done almost entirely by the females and some of the young birds; that it is done with equal frequency at all times of the year by the females when they are present; that it is not connected with mating behavior, and brings no specific response in the male; that it is very different from the begging of the young; that it is not done to startle insects into revealing their whereabouts through motion; that it has no present value to the species.—Ivan R. Tomkins, 1231 East 50th St., Savannah, Georgia.

BOOK REVIEWS

The Ruffed Grouse. Life History. Propagation. Management. by GARDINER BUMP, ROBERT W. DARROW, FRANK C. EDMINSTER, and WALTER F. CRISSEY. (New York Conservation Department, Albany, 1947.) xxxvi plus 915 pp., 4 color plates, 442 illustrations. $10.00.

This monographic treatment of the Ruffed Grouse, with particular reference to *Bonasa umbellus umbellus* as found in New York, richly deserves the award of the Wildlife Society for the best publication in the wildlife field for 1947. This publication reports upon a 13-year investigation of a single species, in all of its aspects, by a host of professional wildlife workers. It is doubted if any single wild avian species has before received such concentrated attention in North America, or elsewhere in the world. The results presented in this publication represent the largest investment ever made in the investigation of a single species of game animal. To carry out an investigation of such magnitude, with so many investigators requires an unimaginable amount of administrative perseverance and ability; it is questionable if a work of such scope will again be attempted for many, many years.

Surely, as Conservation Commissioner Perry B. Duryea states (p. vii), this report graphically points out the rapid strides which have been made in the scientific approach to the management of our wildlife resources in recent years. In addition to Bump, Darrow, Edminster and Crissey, the following individuals are listed authors for one or more sections or chapters: David E. Davis, Fred Everett, S. C. Fordham, Frans C. Goble, Earl R. Holm, John C. Jones, W. Mason Lawrence, Phillip P. Levine, William H. Long, M. E. Phillips, A. L. Romanoff, J. Victor Skiff and John E. Trainer. The color plates are from the able brush of Fred Everett and the sketches are from the pencils of Fred Everett and Clayton B. Seagers. Evidence of careful organization and editing of the entire book is abundant, including diligent cross referencing by footnotes.

The book is divided into four main sections: I—The Ruffed Grouse—Its Background, Basic Biology and Economic Importance (105 pages); II—The Factors that Affect Abundance (476 pages); III—Managing the Grouse Crop (112 pages) and IV—Appendix (192 pages). The space devoted to each of the sections is of interest in indicating the principal emphasis. It is evident that the Investigation devoted a majority of its attention to factors that affect the abundance of this species.

Bump's opening chapter on the history of the grouse gives attention to the fact that the wide variations in the abundance of this bird from year to year were recorded more than a century ago, but they were not recognized as being of a cyclic nature at that time. The periods of scarcity were blamed upon various factors, as many as thirty-six having been listed. These periods of scarcity—which are now recognized as being of a cyclic nature—resulted in directing attention to the species, first in endeavors to propagate it artificially and, beginning in 1929, with the inauguration of the New York grouse investigation. Thus, the history of the grouse is similar to that of many of our other game species; great abundance in colonial times with decreasing numbers as settlement advanced. The pronounced cycles of abundance and scarcity set this species in a category which directed attention to it somewhat earlier than to many other sporting species. So, later historians of the grouse may decree that the cycles of the grouse, although greatly complicating its management, have benefited the species in that it has directed to it some of the most concerted scientific attention received by any form of wildlife. In this manner, grouse cycles and grouse history may finally work together to the best advantage of the grouse which must live under present day conditions—to be utilized wisely or unwisely by man in the habitat which he assigns to it.

Ornithologists who are professionally concerned with our game species often are accused

by sportsmen of being impractical because of their biological approach to the problems confronting them. Chapter II gives the biology, and scientific background, of the grouse and points out in many places the practical value—if not absolute necessity—of such information for the proper management of the grouse. Two examples may suffice; first, Fred Everett's close scrutiny of several hundred specimens of known sex in captivity and in the wild made it possible for him to point out a number of general characters which may be used in separating the sexes and, second, Bump's discussion of the psychology of the grouse lead him to conclude (p. 65) that the existence of a strong dominance complex among grouse, particularly among the males, may be a very important factor which limits the number of grouse that occupy any given habitat. Field usage of the information given by Everett and Bump is at once apparent to the game manager. What has been said of the practical value of the discussions by Everett and Bump applies equally as well to the Chapter II summary of the physiology, pteryology, embryology, growth and development, weights, measurements and related data. Field and experimental data which are summarized in Chapter II are presented in more detail in the appendix.

For the first time known to this reviewer, the cover requirements and the preferences for various cover types at the several seasons of the year are treated adequately for an American game species. In chapter III the results of more than 16,000 man-days afield gathering data on some 19,619 grouse flushes, 1,515 grouse broods and 1,270 nests are analyzed statistically in arriving at conclusions regarding the cover and shelter requirements of this species. Conclusions drawn from such a mass of data leave little room for argument even though these conclusions bear out some popular thoughts on these questions and run counter to other. Adequate investigation of the cover requirements of grouse of various ages and at various seasons of the year was made by the Grouse Investigation. The adaptability of the grouse to a wide variety of cover and food conditions makes it difficult to summarize with definite statements its requirements for cover, food and shelter but the treatment of these questions has been handled admirably by Bump from the mass of data at his disposal.

Ornithologists will be particularly interested in the discussions (pp. 237–241) relating to the chemical composition of some of the various foods taken by the grouse. The requirement of young grouse for a diet with a protein content of 27%, whereas the adults require only a 20% protein food, is of interest in that such protein levels are higher than for most domestic poultry to which many of our game birds often are likened. Chapter III presents data on the analysis of some 1,633 crops of grouse in which were found more than 414 species of plants and 580 different animals remains. One important fact brought out by these workers is that the grouse takes such a wide variety of both animal and plant foods, a large portion of which consists of buds, that it is usually needless for the wildlife manager to concern himself, except in very rare instances, with food production for the grouse by means of artificial plantings or artificial feeding.

Darrow's summarization of the general characteristics of the grouse, or life history, is excellently done. This analysis includes a review of the literature and a summarization of the findings of the investigation on the subject, including several very controversial matters, such as "crazy flights", the manner in which the characteristic sound heard in drumming is produced, flocking characteristics and other pertinent habits. The interpretation of the life history data is made conclusive by the opportunity which the investigators had of checking and rechecking their observations, using the grouse raised at the New York Research Center as observational specimens as well as the very extensive field data on native grouse collected by numerous field workers during the course of the 13 year Investigation. Crissey's discussion of the influence of weather upon the grouse is very thought provoking. One of the outstanding facts brought out by this discussion is that weather conditions account for but few direct losses in the grouse population. There was some relationship shown between weather condi-

tions and periods of grouse scarcity (p. 305), but there is no evidence presented which would show that weather conditions are directly responsible for the grouse cycles of scarcity.

Predation is a controversial subject. Those who would discuss this question, would do well to review the sane discussion of this matter as given by Darrow (Chapter VII). His presentation of the theory of predation and predation control, followed by a detailed discussion of each of the large list of species known to have preyed upon the grouse at one time or another, should be read by every sportsman, game management biologist, legislator and avid protectionist. If this were done, more logic and less sentiment would be evidenced when dealing with this perennial problem in ornithology. The Grouse Investigation produced no evidence which would indicate that efforts to control completely grouse predators have resulted in a permanent increase in the numbers of grouse found on any given area (p. 350).

Seldom has it been possible to assemble sufficient data on the reproductive capacity of any wild animal to permit an intelligent evaluation of the potentialities of any given species. Edminster and Crissey had at their disposal a wealth of information on the reproductive capacity of the grouse which far exceeds that available on most other American avian species. From the data available to them (pp. 353–368), they concluded that occasionally up to 25% of the female grouse may fail to breed in some years; renesting is seldom attempted unless the first nest is destroyed during the egg laying or early incubation periods; the average life expectancy in grouse probably is about 3 years; the sex ratios vary with age and with the seasons, but seldom interfere with the breeding of the grouse; egg infertility averaged 2.6% but rose to an average of 4.3% for renesting attempts; embryo mortality was low, being only 1.9% of the fertile eggs in first nests and 3.9% in renesting attempts, and, finally, inbreeding probably does not occur to any great extent and when it does, exerts no detrimental influence on New York grouse.

The relationship of man to grouse has been roundly discussed. His place as a decimator of the species, by hunting, has been determined by the Grouse Investigation to account for about 17% of the pre-hunting season grouse population (p. 378). Further, little evidence was uncovered by the Investigation which would indicate that the hunter exerts any appreciable depressing influence by his harvest upon the grouse population (p. 380) and may at times even by his hunting " . . . reduce the opportunity for the agents causing periodic scarcities to become effective." As a killer of grouse predators, man's place as a grouse benefactor is questionable as is the position of the fur trapper in reducing fur bearing grouse predators. By cutting timber, cultivating the soil, rearing cattle and in many other ways man has both benefited and destroyed the grouse. Unquestionably, the future welfare of the species rests in the hands of man, more as a manipulator of the habitat than as a hunter, according to Edminster.

Levine and Goble (Chapter X) report upon parasitism and disease basing their conclusions on autopsies of some 1,119 chicks and 1,728 adults from 50 of the 55 counties outside of New York City and Long Island. In this work, which has extended over 11 years, they encountered a number of animal parasites and diseases in the grouse which they examined, but none of them could be assigned the name of "the grouse disease" so common in popular literature and discussions. No evidence was found which would indicate that parasitism or disease has resulted in the periodic fluctuations in grouse abundance. The stomach worm, *Dispharynx spiralis*, was found to be the most pathogenic parasite of wild grouse in certain sections of the Northeast. The distribution of this worm apparently does not extend into all sections of the range of the grouse, however, as other investigators have not found it in grouse specimens examined by them (p. 422). It is of interest to note that neither the blood parasite *Leucocytozoon bonasae*, which has been reported from Ontario and Michigan, nor several other reported grouse blood parasites were encountered in the New York investigations. Dispharynx appears to have caused the death of most of the grouse found dead in the field in the course of the Investigation.

Artificial propagation, in years past, has been suggested as the panacea for our difficulties in producing an inexhaustible supply of wildlife for the hunting public. In the early work with the grouse (Chapter I) artificial propagation of the grouse was attempted by many individuals and such endeavors met with almost complete failure. Bump (Chapter XI) details the systematic evolution of methods which finally resulted in overcoming the difficulties encountered by early grouse raisers. Certain difficulties, principally biological in nature, prevent the artificial production of grouse in the quantities which have been attained with quail and pheasants. Bump is careful to point out in this discussion that the artificial production of grouse, either to restock depleted coverts or to provide birds for the gun, is seldom justified, except in very rare instances. Even further advances in the mass production of grouse in captivity are unlikely to enhance greatly the value of artificial propagation of grouse as a practical wildlife management tool.

Any individual whose activities have been concerned with determining and evaluating animal populations over a period of years will be impressed with the amount of data skillfully presented by Darrow in his discussion of the factors affecting productivity and fluctuations in abundance of the grouse populations (Chapters XII and XIII). Perhaps more detailed data are presented in these two chapters on the fluctuations for the entire year, rather than for spring and fall populations only as is more often the case, than is available for any other species of bird known to this reviewer. Darrow's discussion, based on these data, of such subjects as saturation density, life equation and carrying capacity of various types of habitat is well presented. It probably represents the most complete presentation of these subjects from a factual base which has appeared in literature up to this time. Of course, the subject of cycles is discussed, but he makes no attempt to designate a single factor, or combination of factors, which may account for this phenomenon. The records presented definitely establish the fact that grouse have a more or less periodic fluctuation of abundance within a period of slightly more than 9 years. Such fluctuations do not appear to be precisely synchronized throughout the entire range of the grouse in North America nor do they exhibit this character completely even in one single state.

Part III, which deals entirely with the management of the grouse, will be of major interest to the practicing wildlife manager. In this section, Bump and Edminster have given in detail those factors which must be considered in preparing and executing a management program designed to benefit the grouse. This section of this book will be well thumbed by the wild land administrator, students of wildlife management at our colleges and universities and by the practicing game manager in the field.

The appendix, which covers almost 200 pages will be of value to ornithologists and to professional biologists as well. Detailed discussions of some of the more advanced techniques, the anatomy and pterylography of the grouse, the results of physiological studies of the grouse, grouse foods, forest-wildlife management data and various tables presenting data summarized in the text are given in the appendix. This appendix presents data which are relatively new to the field of wildlife management such as Davis' excellent presentation of the anatomy of the grouse and Long's discussion of the physiology and its relation to the management of this species.

It is no platitude to state that this publication has set a new high for the field of ornithology. True, the information given in it is treated in such detail that casual reading may indicate that it is unduly wordy; close reading will quickly dispel this thought. The completeness with which the subjects are treated and the thoroughness with which they are presented, of necessity, make the cost of this book slightly high for those individuals who would and should make the best use of the data presented. However, the intrinsic value of the publication will more than compensate for the original cost of this book; it is a fine reference tool well worth the cost. It will appear, sooner or later, on the bookshelves of a majority of the ornithologists and conservationists and in the library of many of our sportsmen and biologists. It is a striking ex-

ample of the practical application of ornithological observations and reflects the results of work on many other kinds of birds.

HENRY S. MOSBY

Birds' Nests: A Field Guide. By RICHARD HEADSTROM. (Ives Washburn: New York: 1949.) 128 pp., 61 photos. $2.75.

In winter woods old bird nests are conspicuous objects sure to catch the eye and arouse curiosity as to their makers. While many ornithologists are not likely to be impressed by the importance of identifying such nests, most have probably been the target of queries concerning them at one time or another and certainly teachers and scout leaders are aware of the problem. To aid in satisfying curiosity about nests unattended by birds, this book, covering the United States east of the 100th meridian, has been produced. With it the person of limited field experience may arrive at some reasonable guess concerning the identity of an unknown nest.

Mr. Headstrom's book is essentially a key with the table of contents serving as an outline of the system. The categories are based largely on location and general form, partly on size and other considerations. As is inevitable, some parts are more definite than others; in one place 18 birds come under the same heading. Brief paragraphs help somewhat to distinguish birds grouped under a single heading, though distinctions often seem to be more a matter of vocabulary than of essential meaning. By entering the same bird in more than one place species with variable habits are adequately treated. No scientific names are given, but there is a brief statement on the breeding range of each species. The photographs, well reproduced and grouped at the back of the book in the order of the key, show a variety of nests, mostly with eggs.

HAVEN KOLB

London's Birds. By R. S. R. FITTER. (Collins: London, 1949) 256 pages, 23 illus., 2 maps. 10s. 6d.

Ornithologists have ignored the study of birds in urban habitats for the obvious reason that bird students basically are students of the fields and forests. This book, however, calls attention to the possibilities of obtaining both pleasure and ornithological information by the study of city birds. The birds of the city are described by ecological habitats: buildings, ground, trees and shrubs, marshes, the Thames, and the air.

Of the birds nesting on buildings the Rock Dove receives most attention. The swallow, house martin, and swift nested formerly in many parts of London but now are rare or absent. The explanations for the decline reveal some fascinating environmental relationships. A rapidly increasing species is the Black Redstart which invaded London before the war and utilized the nesting sites provided by the "blitz". Other species such as Wren, Robin, Pied Wagtail, and 3 kinds of tits nest on buildings or other man-made structures. The chapter on roosting contains detailed descriptions of the behavior of the Starlings, a subject sadly neglected in the United States.

Observations of migrations have been very profitable and have shown that many species migrate over the city in large numbers. Other species may be winter or summer residents. The role of predators, especially cats, rats, and gray squirrels, in destroying birds is mentioned. The book concludes with a discussion of man as an enemy and as a friend. A bibliography, list of species, and a detailed index make the texual matter readily available.

This book deserves great praise for its novel viewpoint and its splendid execution. Such a book could not be written for an American city because our ornithologists have neglected the fascinating opportunities. Perhaps this book will stimulate some observers to collect notes on urban ornithology.

DAVID E. DAVIS

Hawks Aloft—The Story of Hawk Mountain. by MAURICE BROUN. (Dodd, Mead Co. 1949) 222 pages, 11 illus. $4.00.

Hawks Aloft is the story of the Great Hawk Slaughter on Hawk Mt., and then of the building on these former shooting stands of the world's first hawk sanctuary. It is a must for all ornithologists and for all conservationists. The story—and many a story within the story—is well told and well-written. Here is a good book—a modern bird classic. It will widen the interests and broaden the outlook of the mere bird-lister. Out of the pure ornithologist it will, or at least should, make a conservationist. Of the general reader it may, or may not, make a bird zealot; but it will at least make a zealot for visiting Hawk Mountain.

In 1932 the cries of dying hawks and wounded decoys still shivered the stillness of the oak-girt cliffs. But in 1934 these same rocks were already echoing the tread of the world's first hawk warden. Shooting was stopped. By 1937 excursion trains for bird watchers—not hunters—were running from Philadelphia to Hawk Mountain for the migration. By the 1940's pictorial automobile road maps showed Hawk Mountain Sanctuary as one of the sights of Pennsylvania. Watchers on the promontory had already included visitors from the Antipodes and Japan.

This achievement is due to Rosalie Edge and to Maurice Broun. Mrs. Edge, unaided by the older orthodox conservation societies, and unfettered by lack of precedent, had plunged ahead. Her vision was to stop the killing, to save the hawks. She took an option on the mountain top, raised money and engaged Broun as curator and warden. Two years later she brought the mountain top outright and set up the Hawk Mountain Sanctuary Association.

Maurice Broun had to be as much a public relations expert as an ornithologist or warden. He braved attacks by drunken hunters and by sober local citizens. He talked softly but firmly. He explained how hawks helped, not hurt, the farmer. And he patrolled the property and protected the hawks. In two years he had converted most of the local gentry. In ten he had made Hawk Mountain known by reputation to every bird lover in North America. Now *Hawks Aloft* brings this conservation success story to the general public.

Within five weeks of its publication last September unprecedented crowds were already parking their cars along the lonely road over the mountain. Thousands of new visitors were thronging the steep trail to the summit. A friend estimated he saw $15,000 worth of field glasses on the promontory at one time on an October Sunday.

This is well. For much education is needed. One promontory saved is good. But other jutting outcrags remain unprotected in Pennsylvania, New York, Virginia and elsewhere. Broun tells about these, too. On them the slaughter goes on. And it will go on until all hawks are protected by law, and by public opinion.

Enlightenment of this public opinion is the job Broun designed for *Hawks Aloft*. It does its job well. Buy it. Read it. Give it to a friend.

HENRY H. COLLINS, JR.

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Recommendations for Preparation of Manuscripts

Manuscripts should be typed on one side of white paper of good quality with title and author's name written on a separate sheet. Everything should be double-spaced and each table should be typed on a separate sheet. Figures, not words, should be used for all numbers (except at the beginning of a sentence). Sex ratios should be calculated as % males. Express data in quantitative and tabular form, wherever possible, and when giving averages, also give the standard deviation. The technical names of the A.O.U. Check List (4th edition), as corrected in the supplements, should be used. Unless specimens have actually been identified to subspecies, only the specific name should be used. Whenever possible a reference for technical names of plants should be listed. Literature should be listed at the end of the article in accordance with the style in previous issues. All articles should have a summary that gives the data in brief form. Authors should avoid footnotes, vernacular phrases, and the use of nouns as adjectives. Illustrations should have good contrast. Printing on charts and maps must be large enough to permit reduction. Cuts of figures will be destroyed unless author requests their return on the reprint order form.

To appear in future issues:

THE SONG OF THE SONG SPARROW

FAMILIAL RECOGNITION IN BIRDS

BREEDING BEHAVIOR OF GOLDFINCHES